

UNITED STATES DISTRICT COURT
DISTRICT OF MASSACHUSETTS

AVIDYNE CORPORATION,
a Delaware corporation,

Plaintiff,

v.

L-3 COMMUNICATIONS AVIONICS
SYSTEMS, INC., f/k/a B.F. GOODRICH
AVIONICS SYSTEMS, INC.,
a Delaware corporation,

Defendant.

Civil Action No. 05-11098 GAO

PLAINTIFF'S RESPONSE TO DEFENDANT'S *MARKMAN* BRIEF

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I. L-3'S MARKMAN BRIEF

L-3's claim construction brief is fundamentally flawed. First, the purpose of claim construction is for the Court to ascertain the meaning of disputed *claim terms*, not, as L-3 suggests, to pick one party's proposed definition over the other. Second, careful consideration must be given to the "comprehensive guidelines" for claim construction articulated by the Federal Circuit in *Phillips v. AWH Corporation*, 415 F.3d 1303 (Fed. Cir. 2005), which L-3 completely ignored. The result for L-3 is a complete lack of support for its proposed claim constructions. Third, many of L-3's arguments are internally inconsistent and unpersuasive. Because of these chronic deficiencies, L-3's proposed construction should largely be ignored.

A. L-3's Submission Does Not Assist The Court for Markman Purposes

L-3's opening Markman submission improperly diminishes the Court's role in the claim construction process. *See generally Markman v. Westview Instruments, Inc.*, 517 U.S. 370 (1996). L-3 has provided the Court with the parties' proposed definitions and has asked the Court to pick one. That type of a request is contrary to law: "[t]he Court must conduct an independent analysis of the disputed claim terms. It is insufficient for the Court to simply choose between the constructions proposed by the adversarial parties." *Id.* at *4. *Toshiba Corp. v. Lexar Media, Inc.*, 2005 U.S. Dist. LEXIS 5213 (Jan. 24, 2005). Indeed, "[b]y improperly focusing on genuinely disputed *meanings* instead of genuinely disputed *claims* as the standard for the parties' briefing ... [L-3] ignores ... the crux of parties' *Markman* disputes: disputes over what the ordinary or accustomed meanings of claim terms are." *Centillion Data Systems, Inc. v. Am. Mgmt. Sys., Inc.*, 138 F. Supp. 2d 1117, 1121 (S.D. Ind. 2001)(emphasis added).

B. L-3 Has Ignored the Federal Circuit's *Phillips* Decision

The Federal Circuit has made clear that the claims define the invention, the rest of the patent instructs the meaning of the claims, and extrinsic evidence, including common dictionaries, may be consulted at any time during the claims construction analysis so long as such evidence is read in the context of the specification. *See generally Phillips*, 415 F.3d 1303. Courts must consider the following hierarchy in undertaking a claim construction analysis: (1) claim language; (2) patent specification and file history; and (3) extrinsic evidence, such as dictionary definitions. But throughout its brief, L-3 confuses or ignores the law in a blatant attempt to broaden the scope of the claims in the U.S. Patent 5, 841, 018 (issued Nov. 24, 1998) (“018 Patent”). For this reason, a detailed analysis of the law is appropriate.

Section 112 of the Patent Act (35 U.S.C. § 112) states:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise and exact terms as to enable any person skilled in the art ... to make and use the same... .

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

This law requires an inventor to set out his invention in the claims. *See also Phillips*, 415 F.3d at 1312. When trying to ascertain the meaning of the claims, the remaining words of the claim element and contained in other claims are highly instructive. *Id.* at 1314. For example, “[b]ecause claim terms are normally used consistently throughout the patent, the usage of a term in one claim can often illuminate the meaning of the same term in other claims.” *Id.* But “[t]he claims ... do not stand alone. Rather they are part of a ‘fully integrated written instrument’ consisting principally of a specification that concludes with the claims.” *Id.* at 1315 citing *Markman v. Westview Instruments* 52 F.3d 967, 978 (Fed. Cir. 1995). It is for this reason that claims “must be read in view of the specification of which they are a part.” *Id.* citing *Markman*

53 F.3d at 979. The specification is usually “dispositive” of the claim construction analysis as it is “the single best guide to the meaning of a disputed term.” *Id.* (citing *Vitronics Corp. v. Conceptronics Inc.*, 90 F.3d 1576, 1582 (Fed. Cir. 1996)).

The Federal Circuit devoted a considerable part of its decision highlighting prior opinions to emphasize the importance of the specification in claims construction. For example, the Court in *Standard Oil Co. v. Am. Cyanamid Co.* 774 F.2d 448, 452 (Fed. Cir. 1985) stated “[t]he specification is ... the primary basis for construing the claims.” And in *Metabolite Labs., Inc. v. Lab. Corp. of Am. Holdings*, 370 F.3d 1354, 1360 (Fed. Cir. 2004) the Court held “[i]n most cases, the best source for discerning the proper context of claim terms is the patent specification wherein the patent applicant describes the invention.” The Federal Circuit in *Kinik Co. v. Int’l Trade Comm’n*, 362 F.3d 1359, 1365 (Fed. Cir. 2004) said “[t]he words of patent claims have the meaning and scope with which they are used in the specification and the prosecution history.” The U.S. Supreme Court has similarly held that “[t]he claims of a patent are always to be read or interpreted in light of its specifications” *Schriber-Schroth Co. v. Trust Co.*, 311 U.S. 211, 217 (1940) and “[a] claim term can be defined only in a way that comports with the instrument as a whole.” *Markman v. Westview Instruments* 517 U.S. 370, 389 (1996). In summary

[T]he interpretation to be given a term can only be determined and confirmed with a full understanding of what the inventors actually invented and intended to envelop with the claim. *The construction that stays true to the claim language and most naturally aligns with the patent’s description of the invention will be, in the end, the correct construction.*

Renishaw PLC v. Marposs Societa’ per Azioni, 158 F.3d 1243, 1250 (Fed. Cir. 1998) (emphasis added).

The specification may also define claim terms “by implication such that the meaning may be found in or ascertained by a reading of the patent documents.” *Phillips* 415 F.3d at 1321. Claim terms need not only be defined in the specification by express definitional format. *Id.* While care must be taken to avoid importing limitations from the specification into the claims, the “line between construing terms and importing limitations can be discerned with reasonable certainty and predictability if the Court’s focus remains on understanding how a person of ordinary skill in the art would understand the claim terms.” *Id.* at 1323. The correct claim construction is assured when one keeps in mind “that the purposes of the specification are to teach and enable those of skill in the art to make and use the invention and to provide a best mode for doing so.” *Id.* After reading the specification in this context “it will become clear whether the patentee is setting out specific examples of the invention to accomplish those goals, or whether the patentee instead intends for the claims and the embodiments in the specification to be strictly coextensive.” *Id.*

Extrinsic evidence may be consulted but must be considered in the context of the intrinsic record because it is “less reliable than the patent and its prosecution history in determining how to read claim terms... .” *Phillips* 415 F.3d at 1318. It is considered “less reliable” for several reasons. First, such evidence is not part of the patent. *Id.* Second, it “may not reflect the understanding of a skilled artisan in the field of the patent.” *Id.* Third, expert testimony is generated for litigation so is susceptible to bias not found in intrinsic evidence. *Id.* Fourth, the universe of extrinsic evidence may not be relevant to the claims in dispute and may just serve to confuse rather than to assist. *Id.* Finally undue reliance may change the meaning that the claims should have as described in the patent. *Id.* at 1318-19. In sum, while extrinsic evidence may be consulted, such evidence must be “considered in the context of the intrinsic evidence.” *Id.* at

1319. This is because “discrepancies between the patent and [extrinsic evidence] are apt to be common because the patent by its nature describes something novel. *Id.* at 1322. Because L-3 did not offer a construction based on these principles, their proposals are necessarily flawed as a result.

1. The Law is Clear that Claim Constructions that Incorporate the Teachings of the Intrinsic Record is Appropriate.

Case law subsequent to *Phillips* instructs that the entire specification be considered and claim terms be defined within the context of the intrinsic record. The “claims down” approach advocated by L-3 is inconsistent with the law, and results in significant claim distortion. Courts should not – as L-3 contends – begin with the plain meaning of disputed claim terms and whittle down that meaning only if there is a clear disavowal of claim scope. (*See Cytoc Corp. v. TriPath Imaging, Inc.*, 2005 U.S. Dist. LEXIS 29850, *8-11 (D. Mass. Nov. 28, 2005); *compare generally Texas Digital Systems, Inc. v. Telegensix, Inc.*, 308 F.3d 1193 (Fed. Cir. 2002) and *Phillips v. AWH Corp.* 415 F.3d 1303 (Fed. Cir. 2005) (*Phillips* explicitly overruled the *Texas Digital* line of cases). Rather, as articulated in *Phillips*, an interpretation of claim terms based on the patent as a whole must be made with the Court “rely[ing] heavily on the written description for guidance as to the meaning of the claims.” *Phillips*, 415 F.3d at 1317. Claim terms must be defined by the teaching of the intrinsic record especially when (1) the specification provides no alternative in which to practice the patent, (2) the structure described throughout the specification is the only one possible for the invention to work, (3) the specification teaches only one way to achieve a desired result, (4) the specification narrows the definition because a broader reading is not supported by the patent, or (5) the specification describes an inherent characteristic not necessarily defined by the claims themselves. In addition, a claim term is to be construed in light of the specification in its entirety.

a. The Specification Suggests No Alternative to a Definition that Incorporates a Structural Component

The parties in *Cytec Corp.* sought construction of (among others) the terms “displaying” and “visual display”. *Cytec Corp.*, 2005 U.S. Dist. LEXIS 29850 at *32. TriPath proposed the definition “spreading before the view” and “a display made available to a human observer,” for the respective terms. *Id.* Cytec argued that “presenting information on a computer screen” is the correct interpretation even though the claims do not mention a computer. *Id.* The Court, agreeing with Cytec, stated “[t]he claims themselves do not specifically mention a computer monitor, but properly read, the intrinsic evidence suggests no alternative.” *Id.* at *33. First, “the Summary of the Invention indicates only one possible mechanism for displaying digital images or objects: a monitor.” *Id.* at *34. Second, “Figure 1 is a diagram ‘of a cytological classification or screening device in accordance with the present invention.’ It shows a high resolution monitor as the mechanism for display.” *Id.* at *34. Third, “[t]he Detailed Description of the Invention repeatedly mentions displays on a ‘summary screen’.” *Id.* at *34. The Court continued “[s]ome of these reference are, to be sure, with respect to the preferred embodiment. Keeping in mind that a Court must not read a preferred embodiment as a limitation on the claim...the written description still points towards a monitor as the only display mechanism.” *Id.* at *34. The Court concluded that “the definitions of “displaying” and “visual display” [were] limited to the structures or their equivalents actually described in the specification.” *Id.* at *36.

b. For a Claim Term to Have Meaning It Can be Defined by a Functional Limitation Disclosed in the Specification.

In *Flex-Rest, LLC v. Steelcase, Inc.*, 455 F.3d 1351 (Fed. Cir. 2006), Flex-Rest argued that the term “sidewall” as used in the patent at issue does not include a directional limitation. Steelcase argued that “the specification and prosecution history make clear that ‘sidewall’ is part of the ‘support surface’ and can only serve its function if it extends upward from the ‘support

surface.” *Id.* at 1361. The Court found that “[t]he written description makes clear that in order for a ‘sidewall’ structure to support the keyboard, it must extend upwardly; if ‘sidewalls’ extend downwardly, they would not interact with or play any role in supporting the keyboard.” *Id.* The Court concluded its analysis stating “[s]uch a requirement does not improperly read a limitation from the specification into the claim. Rather, the written description and the drawings make clear that when the claim refers to ‘sidewalls’ of a support surface, the claim language refers to upward-extending walls.” *Id.*

c. A Claim Term May be Limited to the Teaching of the Specification When the Intrinsic Record Describes Only One Way of Achieving the Patented Result.

Also of note is the Federal Circuit’s decision in *Invitrogen Corp. v. Clontech Lab., Inc.*, 429 F.3d 1052 (Fed. Cir. 2005). The lower Court had defined certain claims by reference to gel assay results. For example, claims 3 and 4 related to a polypeptide with no detectable RNase H activity or a polypeptide that lacked RNase H activity. *Id.* at 1074. These claims did not make any reference as to how one skilled in the art could make an assessment of the level of RNase H activity. The Court held that the terms “no detectable” and “lacks” cannot be “understood without reference to the written description... .” *Id.* at 1076. The Court said that “[a]lthough the ’608 patent specification does not expressly define either term [“no detectable” or “lacks”], it unmistakably teaches how one skilled in the art would determine that a mutant RT ‘completely lacks’ RNase H activity. *Id.* The specification describes a gel assay in detail, the results of which were provided in Figure 5 of the patent. *Id.* at 1077. “With this primacy placed on the gel assay results, the patent unmistakably instructs one skilled in the art to measure RNase H activity, for the purposes of claims 3 and 4, by using a gel assay.” *Id.*

d. Claim Language Should Be Construed Only As Broadly As The Specification Defines The Term

The Federal Circuit was required to ascertain the meaning of “board” in *Nystrom v. TREX Co., Inc.*, 424 F.3d 1136 (Fed. Cir. 2005). Nystrom argued that ‘board’ “is not limited to conventional wood boards that are cut from a log. ... [T]he claim language ... does not contain a description of the material from which the board is composed and the claim should not be so limited.” *Id.* at 1142. TREX asserted that “board” should be defined as it was used in the specification, that is, “a piece of sawn lumber”. *Id.* at 1142. The Federal Circuit agreed with TREX. It stated that the Background of the Invention “frames the invention in the context of wood decking materials cut from logs” and that “context is maintained throughout the written description” including in the figures. *Id.* at 1143. Nystrom in this case committed the same error that L-3 now makes by arguing that “there is no disavowal of scope in the written description or the prosecution history.” *Id.* at 1145. The Court counseled that “[a]lthough there was no clear disavowal of claim scope, there was nothing in the intrinsic record to support the conclusion that a skilled artisan would have construed the term ‘board’ more broadly than a piece of construction material made from wood cut from a log.” *Id.*

e. A Claim Term Can Be Defined By An Inherent Characteristic Described in the Specification.

The Federal Circuit’s decision in *Ocean Innovations, Inc., v. Rick Archer* 145 Fed. Appx. 366 (Fed. Cir. 2005) is also instructive. In that case the Court was asked to construe the term “floatation units”. The Abstract, Background of the Invention, Summary of the Invention, and the Preferred Embodiment described the units as hollow. The Court stated that “we do not think that to construe the ‘floatation units’ as hollow is importing a limitation into the claims when the specification makes clear that hollowness is an inherent characteristic of the ‘floatation units’ in the claimed invention.” *Id.* at 371. *Ocean* and *Phillips* make it clear that characteristics inherent

to the operation of a claimed element are properly incorporated into the definition of that element.

f. A Claim Term Must Construed as Taught by the Intrinsic Evidence Considered in its Entirety.

The Federal Circuit in *Network Commerce, Inc. v. Microsoft Corp.*, 422 F.3d 1353 (Fed. Cir. 2005) ascertained the proper construction by defining a claim term consistently with the intrinsic record as a whole while disregarding a disclosed embodiment that contradicted the general teachings of the specification. This case concerned a method and system patent for “purchasing electronic information over a computer network.” *Id.* The Court was asked to construe the meaning of the term “download component.” *Id.* Interestingly, the specification did not contain “download component.” *Id.* at 1360. The Court decided that the term “download file” which did appear throughout the specification had a function and description that closely aligned with the function and description of download component as used in the claims. *Id.* The Court decided that these two terms were therefore interchangeable.

The Court then construed “download component” in light of the specification’s teaching of download file: “This file when downloaded into the customer’s computer ‘extracts [from the download file] the executable boot program and component list.’” *Id.* The Court concluded that “while the download file may contain different things, the specification indicates that it must contain at least the boot program.” *Id.* at 1360. The Court ultimately decided that the term “download component” is correctly construed in light of how the specification defines it: “[T]he specification makes clear that the download component must include a boot program, and the boot program interacts directly with the operating system of the computer without the assistance

of any other program.” *Id.* at 1360-66. The term “download component” was defined accordingly.

Notably, the Court rejected Network Commerce’s argument that the specification discloses an embodiment in which “the boot program already resides on the customer’s computer when the download component is received ... and the term “download component” should therefore not be construed to include the boot program.” *Id.* at 1361. The Court found this argument unconvincing because it was inconsistent with the teaching of the specification when considered as a whole and because no other method of practicing the patent is disclosed. “Download of the boot program is discussed repeatedly and no other method of obtaining the boot program is disclosed.” *Id.* Therefore, primacy is placed on what the specification actually teaches and discloses and not on non-enabling statements regarding certain embodiments.

II. THE PARTIES POSITION AFTER OPENING BRIEFS

The Parties submitted the following proposed constructions to the Court in their Opening Markman briefs:

Disputed Claim Language	Avidyne’s Proposed Construction of Disputed Terms	L-3’s Proposed Construction of Disputed Terms
(Preamble) Compensating for installation orientation of an attitude determining device	<i>Does not require construction</i>	Adjusting to neutralize the effect of the orientation of an attitude determining device as installed.
Attitude Determining Device	A device that includes sensors and a processor for processing the output of the sensors to determine attitude.	A piece of equipment that determines angular orientation relative to the earth frame and is used to establish the attitude of a craft.
Sensing the installation orientation of said attitude determining device with respect to said earth frame coordinate system when said craft is at rest to obtain a static orientation measurement of said device.	Automatically determining the angular position of the installed attitude determining device relative to earth frame while the craft is not moving to obtain a static orientation measurement of the device.	Detecting an angular orientation with the installed attitude determining device relative to earth frame while the craft is not moving to obtain a static orientation measurement of said device.

Disputed Claim Language	Avidyne's Proposed Construction of Disputed Terms	L-3's Proposed Construction of Disputed Terms
Measuring an attitude of said mobile craft with said attitude determining device	Processing the output of the sensors of the attitude determining device to determine a pre-compensated attitude of the mobile craft.	Using the attitude determining device to measure an angular orientation of the mobile craft.
Compensating said craft attitude measurement of said device with said static orientation measurement to obtain attitude information of said craft's reference coordinate system with respect to said earth frame coordinate system.	Applying said static orientation measurement (determined in said sensing step) to the pre-compensated attitude of the craft (determined in said measuring step) to mathematically correct the pre-compensated attitude of the craft (determined in said measuring step) by adjusting for the difference between that pre-compensated measured attitude of the craft and the craft's actual attitude relative to the earth frame.	Using the static orientation measurement to neutralize the craft attitude measurement for the installation orientation of the attitude determining device to obtain the orientation of the craft relative to the earth.
Storing said static orientation measurement in memory	Persistently retaining the static orientation measurement in a memory.	Retaining static orientation measurement data within the attitude determining device.
Retrieving said static orientation measurement from said memory to a processor of said device.	Obtaining the previously stored static orientation measurement and feeding it to the processor of the attitude determining device.	Providing static orientation measurement data to an electronic computational device within the attitude determining device.
Compensating said craft attitude measurement with said retrieved static orientation measurement in said processor to obtain attitude information of said craft's reference coordinate system with respect to said earth frame coordinate system.	Applying said retrieved static orientation measurement (determined in said sensing step) to the pre-compensated attitude of the craft (determined in said measuring step) in said processor to mathematically correct the pre-compensated attitude of the craft (determined in said measuring step) by adjusting for the difference between that pre-compensated measured attitude of the craft and the craft's actual attitude relative to earth.	Using the static orientation measurement data in an electronic computational device to neutralize the craft attitude measurement for the installation orientation of the attitude determining device to obtain an orientation of the craft relative to the earth.

The Court should note, where L-3 discusses definitions proposed by Avidyne in its brief, those *are not* definitions Avidyne submitted to the Court in its opening brief. Those were the

preliminary proposals Avidyne had formulated to facilitate negotiations with L-3 in an attempt to narrow the number of disputed claims. Avidyne modified its definitions after reviewing L-3's initial proposals and again after further analysis and investigation as to the proper meaning of the disputed claims. Again, L-3's attack on constructions not proffered to the Court is misleading and does not help the Court construe the claims.

III. L-3'S PROPOSED CONSTRUCTION

A. Preamble

L-3 asks this Court to elevate the preamble to a claim limitation but misunderstands the legal standard, which clearly demonstrates that such treatment is inappropriate. The Federal Circuit has held that a preamble is a claim limitation if it "recites essential structure that is important to the invention or necessary to give meaning to the claim." *Bicon, Inc. v. Straumann Company*, 441 F.3d 945, 952 (Fed. Cir. 2006). *See also Cytoc Corp.* 2005 U.S. Dist. LEXIS 29850 at * 42 ("[a] preamble 'limits the invention if it recites essential structure or steps, or if it is necessary to give life, meaning, and vitality to the claim'")(citations omitted). But "a preamble is not limiting where a patentee defines a structurally complete invention in the claim body and uses the preamble only to state a purpose or intended use of the invention" *Id.* Here, the preamble to claims 1 and 16 merely provides a summary of the method and does not include function or structure that are not found in the claim elements themselves.

The preamble reads:

A method of compensating for installation orientation of an attitude determining device on-board a mobile craft with respect to a reference coordinate system of said craft to obtain attitude information of said craft from said device based on an earth frame coordinate system, said method comprising the steps of:

L-3 has requested the Court adopt the following construction:

A method of **adjusting to neutralize the effect of the orientation of an attitude determining device as installed** on-board a mobile craft with respect to a

reference coordinate system of said craft to obtain attitude information of said craft from said device based on an earth frame coordinate system, said method comprising the steps of:

But L-3 has not articulated any basis for elevating the preamble to a limitation of claims 1 and 16.

1. The Preamble Does Not Recite Essential Steps

The four steps required to practice the '018 Patent are essentially to: (1) install an ADD on a craft at an unknown orientation; (2) sense the installation orientation of the ADD to obtain a static orientation measurement; (3) measure an attitude of the craft; and (4) compensate that attitude with the static orientation measurement to obtain the correct attitude of the craft. The preamble adds nothing to the claim elements. To be sure, it could be removed and one skilled in the art could still practice these steps.

L-3 argues that the inventors of the '018 Patent relied on the preamble for the patent to issue and that in-and-of-itself is enough to make it a necessary element of the claim. The standard, however, is clear reliance. *Catalina Mktg. Int'l v. Coolsavings.com, Inc.*, 289 F.3d 801, 808 (Fed. Cir. 2002). And the section of the prosecution history referenced by L-3 in its attempt to meet the clear reliance standard actually shows that the inventor relied on the claim elements, not the preamble, to overcome an obviousness rejection. The language on which L-3 relies provides:

Independent claims 1 and 16 recite, in substance, a method of compensating for installation orientation of an attitude determining device on board a mobile craft comprising the steps of 1) installing the attitude determining device at an unknown orientation with respect to the reference coordinate system of the craft, 2) sensing the installation orientation while the craft is at rest to obtain a static orientation measurement of the device, and 3) compensating the craft attitude measurement of the device with the static orientation measurement. (emphasis original).

All the major clauses of the preamble are covered by the subsequent numbered clauses:

Installation orientation of an attitude determining device is covered by clause 1 and compensating is covered by clause 3. In fact, there is not a single word or phrase in the preamble that is not expressly recited in the method steps of the claims. More importantly, the emphasis in this text is placed on “unknown” in as it appears in clause 1. Significantly, the word “unknown” is not found in the preamble. Thus, it was reliance on *unknown* in claim element 1 that overcame the obviousness rejection and not the preamble.

L-3 is attempting to unduly broaden the claimed compensating step by proffering a broad definition of the “compensating language in the preamble”, language that is not in context with the compensating step recited later in the claim and discussed below. Further, there is no support in the specification for the “adjusting” and “neutralizing” language proposed by L-3. These terms are not found in the ‘018 patent. On the contrary, the ‘018 patent teaches that compensation is a mathematical process performed on a calculated attitude. This is discussed in greater detail below also.

2. L-3’s Proposal Would Make the Title of the Patent a Claim Element.

L-3 would have this Court conclude that part of the preamble – the phrase “compensating for installation orientation of an Attitude Determining Device” – recites an essential structure of the invention or is necessary to give life and meaning to the claim. Far from reciting an essential step, this phrase merely repeats the title of the patent, which summarizes the intended use of the invention and is of no significance to claim construction. Indeed, “the purpose of the title is not to demarcate the precise boundaries of the claimed invention but rather to provide a useful reference tool for future classification purposes.” *Pitney Bowes, Inc. v. Hewlett-Packard Co.*, 182 F.3d 1298, 1312 (Fed. Cir. 1999) (citing United States Patent and Trademark Office *The Manual of Patent Examining Procedure*). This phrase adds no real meaning but “state[s] a

purpose or intended use of the invention” *Cytec Corp.* 2005 U.S. Dist. LEXIS 29850 at 42. The only phrase from the preamble that L-3 asserts as essential to the elements of claims 1 and 16 adds nothing to the claim and certainly cannot be considered a necessary element.

B. Attitude Determining Device

L-3 proposes that the term “Attitude Determining Device” should be construed as “a piece of equipment that determines angular orientation relative to the earth frame and is used to establish the attitude of a craft.” This interpretation does not accurately reflect what an attitude determining device does: determine attitude. More importantly, it does not reflect how attitude is determined in the context of the ‘018 Patent, which is by using sensors and a processor. Avidyne’s interpretation, “a device that includes sensors and a processor for processing the output of the sensors to determine attitude”, is supported by the claims, intrinsic record, and the *current* law on claim construction.¹

1. The Patent Claims Specifically Reference that an ADD need a Processor in the ‘018 Patent.

L-3 argues that because claim 1 does not mention a processor as part of the Attitude Determining Device, the construction of the claim cannot include that word. (Def. Op. Brief page 12-13). While it is correct that claim 1 does not mention a processor, claim 16 specifically does: “retrieving said static orientation measurement from said memory to a processor of said device...” (‘018 Patent 8:18-20). L-3 contends that the inventors included the word processor when they wanted to and likewise excluded it from other claims like claim 1 intentionally. L-3’s analysis is flawed.

¹ This section of L-3’s brief is the first of many attempts to undermine a definition not proffered by Avidyne. Avidyne does not include the terms gravity and motion sensor as a proposed definition for Attitude Determining Device in its Opening Markman brief. Much of L-3’s argument relating to this term can therefore be ignored as irrelevant.

First, L-3 has violated *Phillips* by not reading this element in context of the intrinsic record. The primary purpose for including the word “processor” in claim 16 is to satisfy the retrieving step in the methodology. Of significance is that the ‘018 Patent relates to a method and not the device itself. Contrary to L-3’s contention, a “processor” was not added to the ADD in claim 16. Rather, the patentee recognized that to satisfy the retrieval step, which clearly requires a “processor” that is inherent to the ADD, it had to refer specifically to the “processor” in the claim limitation of claim 16. Avidyne’s proposed interpretation of Attitude Determining Device does not add a limitation to the claim, as L-3 contends, but instead supports what the remainder of the patent teaches, that an ADD, within the context of the ‘018 Patent, must inherently have a processor. It is the storing and then the retrieving that differentiates claim 16 from claim 1, not one Attitude Determining Device with a processor and another without.

Second, L-3 ignores that claim terms are normally used consistently throughout the patent... .” *Phillips* 415 F.3d at 1314. L-3’s construction would result in differing meanings of an ADD. An ADD in claim 1 would be without processor while an ADD in claim 16 would have a processor. There is not rational basis for such an odd result. Only one ADD is described in the patent and that is one that includes a processor. L-3’s argument is not consistent with language of the claims.

2. The Specification Teaches That the ADD Must Contain Sensors and a Processor.

L-3’s argues that unless the specification includes “language evidencing a clear disavowal of claim scope” then the teaching of the specification does not impact the claim’s meaning. (Def. Op. Brief. Page 14-15). On this shoddy legal foundation, L-3 concludes that the inclusion of “sensors” and “processor” in the definition of Attitude Determining Device is

inappropriate. L-3 has not followed the law and has made the same critical mistake as the plaintiff in *Nystrom* – relying on there being no clear disavowal and ignoring the intrinsic record.

The current state of the law clearly supports including the terms processor and sensors in the definition of ADD because the specification supports such a construction. See generally *Phillips* 415 F.3d 1303; *Invitrogen Corp.*, 429 F.3d at 1076-77; *Nystrom*, 424 F.3d at 1143; *Ocean Innovations, Inc.*, 145 Fed. Appx at 371; *Cytec Corp.*, 2005 U.S. Dist LEXIS 29850 at 33-34; *Network Commerce*, 422 F.3d 1353. The ‘018 Patent describes no Attitude Determining Device other than one that contains sensors and a processor. Indeed, a machine cannot “sense” without sensors. In addition, the methodology relies on the ADD having these inherent components in order to function. For example, Figures 5 and 6 of the ‘018 Patent illustrate the ADD 20 having sensors 50 and 56 and processor 52. Also, the only example of an ADD described in the ‘018 Patent includes sensors and a processor (‘018 Patent 3:25-40). The reason for this is plain: it is not reasonably possible for an electronic device to sense and then determine attitude without sensors and a processor.

Considering the wealth of authority that supports Avidyne’s construction, the definition of Attitude Determining Device as used in the ‘018 Patent must include reference to sensors and a processor. Indeed, the ‘018 Patent does not reference an ADD that does not incorporate a processor or sensors. *Network Commerce* 422 F.3d at 1360 (“while the download file may contain different things, the specification indicates that it must contain at least the boot program.”); *Cytec Corporation* 2005 U.S. Dist. LEXIS 29850 at *33 (“the claims themselves do not specifically mention a computer monitor but properly read, the intrinsic evidence suggests no alternative.”)

The '018 Patent Abstract states that an ADD "senses its installation orientation". ('018 Patent, Abstract). As the patent explains, this can only be achieved by the ADD's internal sensors. ('018 Patent 3:12-40). The Background of the Invention states "[t]he static installation orientation is automatically determined [later described as a function of the sensors at '018 Patent 4:12-13] by the device itself and the attitude measurement is compensated therewith in a processor of the device." ('018 Patent 1:59-62). The ADD must have sensors to "automatically" perform the sensing described. Also, this passage clearly requires the ADD to have a processor. Figures 5 and 6, a preferred and alternative embodiment of the ADD both depict sensors and a processor. (Pl. Op. Brief. Page 8-10.) And yes, L-3 is correct, the Description of the Preferred Embodiment is littered with references to sensors and a processor in the ADD. ('018 Patent 3:19-40; 3:67-4:6; 4:10-13; 4:40-41; 4:59-67).

L-3 argues that even though the Preferred Embodiment includes reference to a processor and sensors, this is not sufficient to include sensors and a processor in the definition of Attitude Determining Device. In light of significant authority to the contrary, L-3 is wrong. For example, the Federal Circuit in *Nystrom* found the specification's repeated and consistent reference to a board made of wood persuasive to construe that claim term accordingly. *Nystrom* 424 F.3d at 1145. That is, "there was nothing in the intrinsic record to support the conclusion that a skilled artisan would have construed the term "board" more broadly than a piece of construction material made from wood cut from a log." *Id.* The same is true of the '018 Patent and an ADD. In addition, not only does the '018 Patent explicitly and implicitly require an ADD of the '018 Patent to have sensors and a processor, the patent does not provide for any other alternative or explain how to practice the patent with an ADD that does not have sensors and a processor.

Cytec Corp., 2005 U.S. Dist. LEXIS 29850 at *33-35; *Network Commerce*, 422 F.3d at 1361; *Invitrogen*, 429 F.3d at 1077.

Therefore, a definition of Attitude Determining Device must incorporate sensors to sense motion of the craft and a processor to calculate the attitude based on the sensed motion.

Avidyne’s construction that Attitude Determining Device is a device that includes sensors and a processor for processing the output of the sensors to determine attitude “stays true to the claim language and most naturally aligns with the patent’s description of the invention [and therefore is] the correct construction.” *Phillips* 415 F.3d at 1316 (citing *Renishaw*, 158 F.3d at 1250).

3. L-3 Offers No Support for Its Own Construction of Attitude Determining Device

L-3 offers no support for its own construction but rather contends that its “definition is consistent with the broad definition keyed to the function of the “device” as provided by the Background and Summary of the Invention, rather than specific examples mentioned in the Description of the Preferred Embodiment.” (Def. Op. Brief page 16). L-3 would have the Court adopt as a definition for Attitude Determining Device “a piece of equipment that determines angular orientation relative to the earth frame and is used to establish the attitude of a craft.” The only reference L-3 makes to the Summary of the Invention and Description of the Preferred Embodiment is in the context of seeking to undermine Avidyne’s construction and not to support its own.

Finally, L-3’s proposal is an incredibly broad construction that disregards the teachings of the specification. Most troubling is L-3’s argument that an ADD “... *is used* to establish attitude”. An Attitude Determining Device must output an attitude. This function is explicit in its name but also in the claims and the specification. Element 3 and 4 of claims 1 and 16 respectively state that the attitude determining device measures an attitude. This same

description of what an ADD does, therefore what it is, is also repeated in the specification. For example, “attitude determining devices for mobile craft ... measure the *attitude* of the moving craft...” (‘018 Patent 1:15-17)(emphasis added). And later the specification describes that “... calculations are conventionally performed by a processor internal to the [attitude determining] device ... to produce an attitude solution...”. (‘018 Patent 3:35-38). Figures 5 and 6, a suitable and alternate embodiment of an “attitude determining device”, also describe the Attitude Determining Device outputting an attitude.

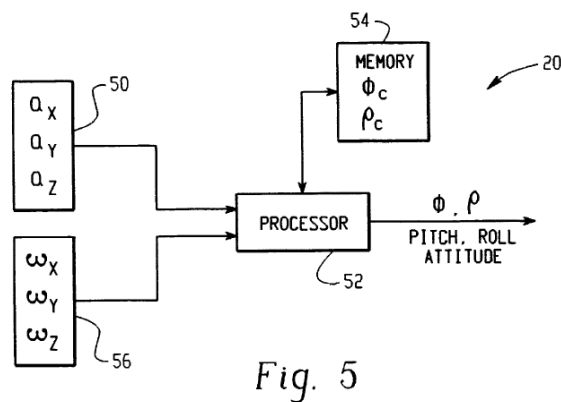


Fig. 5

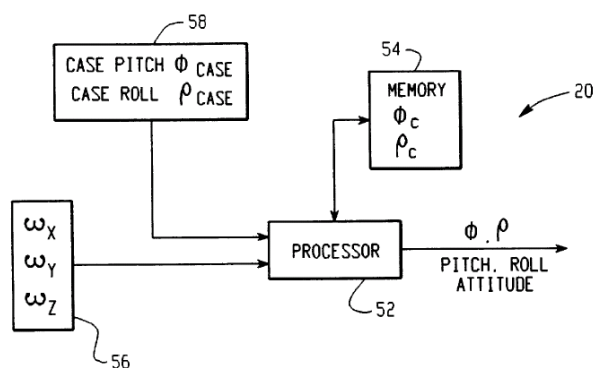


Fig. 6

Even though a processor and sensors are required components of an ADD, there can be no dispute that the output of an ADD must be attitude. It is not just a device that can be used to establish attitude as L-3 suggests. Using L-3's logic, a building can be defined as "cement" because cement is used to establish a building. L-3's proposed construction "used to establish the attitude of a craft" is far too broad to be acceptable in this instance because such a construction would be devoid of the true meaning of the term Attitude Determining Device as used in the '018 Patent. As the Court in *Nystrom* held, a party is "not entitled to a claim construction divorced from the context of the written description and prosecution history." *Nystrom*, 424 F.3d at 1144-45.

4. L-3's Own Proffered Construction Supports Avidyne's Position

Finally, L-3 submits that the retrieving step of claim 16 should be construed as "providing static orientation measurement data to an *electronic computational device* within the attitude determining device. (emphasis added). The "computational device" is a processor. The fact that L-3 admits that a computational device is within the ADD is further evidence of the fact that a processor is an inherent requirement of an ADD. Interestingly, the phrase "computational device" is not found anywhere in the claims specification or file history of the '018 Patent, which uses the more accepted term "processor." Restricting the ADD's processor to an electronic computational device would unduly narrow the definition of attitude determining device in the '018 Patent. The processor of the '018 Patent can encompass much more than an electronic computational device and the Court should adopt a definition reflective of that fact.

C. Sensing the Installation Orientation of Said Attitude Determining Device with Respect to Said Earth Frame Coordinate System When Said Craft is at Rest to Obtain a Static Orientation Measurement of Said Device.

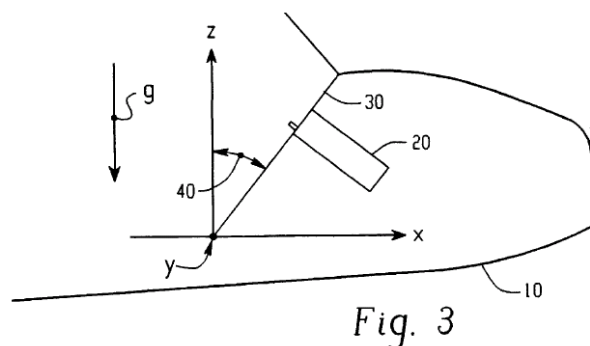
L-3 would have this element mean “detecting an angular orientation with the installed attitude determining device relative to earth frame while the craft is not moving to obtain a static orientation measurement of said device.” In considering this construction, the Court should note that L-3 again makes the mistake of arguing against a definition not proposed by Avidyne. Nevertheless, the main thrust of L-3’s argument is its disagreement with Avidyne’s use of the word “position” in its construction. This element should be construed to mean “automatically determining the angular position of the installed attitude determining device relative to earth frame while the craft is not moving to obtain a static orientation measurement of the device.” L-3’s construction has several insurmountable hurdles.

First, L-3 ignores that it has already agreed that orientation means angular position. As set out in the *Stipulation As To Agreed-Upon Claim Construction* (attached as Exhibit 2 to Avidyne’s Opening Brief) L-3 agreed that “unknown orientation with respect to said reference coordinate system of said craft” means “unknown *angular position* of the installed attitude determining device relative to the reference frame of the craft.” (emphasis added). Focusing on the operative words for this present discussion, orientation is defined as “angular position.” The same language should apply to the sensing step because “claim terms are normally used consistently throughout the patent...” *Phillips*, 415 F.3d at 1314.

Second, L-3’s only argument against the using the word position is that it is confusing because it suggests a location on the craft. It appears that L-3 is ignoring the linguistic reality that the term “angular” modifies the term “position.” Hence, Avidyne is not proposing any random position on the craft but the angular position of the ADD. L-3 would apparently prefer to use the term orientation for no other reason other than the fact it does not relate to a specific

location. But L-3 describes this step as determining a position earlier in its brief. In summarizing this element on page 5, L-3 states “[t]he attitude determining device is used to sense information for determining the *position* of the device itself while the craft is at rest” and cites to 1:66-2:4 in the ‘018 Patent as support. (Def. Op. Brief. Page 5). L-3 then relies on this same passage of the Patent to argue *against* the use of “position” (Def. Op. Brief Page 20-22).

Third, considering the entire element in context, “position” is an appropriate word to use in the definition of this step. Avidyne’s proposal requires the angular position of the ADD to be determined *relative to earth frame*, not just the position of the device within the craft. As described in Avidyne’s Opening Brief, the ADD in this step must determine the unknown angle of its installation with respect to earth frame. Avidyne’s proposed definition incorporating “angular position ...relative to earth frame” accurately describes what is depicted in Fig. 3. of the ‘018 Patent: the unknown angular position (40) of the installed ADD. (When the craft is level, the earth frame matches the craft’s reference coordinate system).



For all these reasons, the Court should reject L-3’s proposal and interpret this element to be “automatically determining the angular position of the installed attitude determining device

relative to earth frame while the craft is not moving to obtain a static orientation measurement of the device.”

D. Measuring an Attitude of Said Mobile Craft with Said Attitude Determining Device

L-3 suggests this claim element should be construed to mean “using the attitude determining device to measure an angular orientation of the mobile craft.” This construction is a desperate attempt by L-3 to broaden the scope of ‘018 Patent, which, if accepted, would violate well settled law and render the installation (first step), sensing (second step) and compensating (fourth step) unnecessary. The ‘018 Patent could not be clearer that only after completing all the claimed steps is the actual attitude of the craft determined.

1. Claims

Analyzing all of the claim elements is clearly appropriate here to arrive that the appropriate construction of the measurement step because throughout its “measuring” section, L-3 repeatedly tries to read claim elements out of existence. Indeed, L-3 ignores that the claims recite a sequential ordering of the elements and refuses to acknowledge that where claim language actually refers back to previous steps then the elements of the claim must be followed in sequential order. *Thorn EMI N. Am., Inc., v. Intel Corp.* 928 F. Supp. 449, 457 (D. Del. 1996). L-3 also “disregard[s] the basic patent law doctrine that every limitation of a claim is material” *Flex-Rest, LLC* 455 F.3d at 1361 (Fed. Cir. 2006) (citing *Warner-Jenkinson Co. v. Hilton Davis Chem. Co.* 520 U.S. 17, 29 (1997)).

- a. Element 1: Installing said attitude determining device on-board said mobile craft at an unknown orientation with respect to said reference coordinate system of said craft.

The parties agreed that Installing said Attitude Determining Device on-board said mobile craft means securing, mounting, or affixing the attitude determining device to the mobile craft. It is plainly evident that in order to practice this patent and to determine an attitude of a craft, an

ADD must be “installed” on a craft. The remainder of this element merely describes the problem that this patent addresses: that the ADD is installed at an unknown angular position relative to the reference frame of the craft. Indeed, there must be this problem before this patent can resolve it. Therefore, element 1 of Claims 1 and 16 can rightly be considered the first or “installation step.”

- b. Element 2: Sensing the installation orientation of said attitude determining device with respect to said earth frame coordinate system when said craft is at rest to obtain a static orientation measurement of said device.

In this “sensing step” the ADD’s installation orientation is sensed. The ADD must already be *installed* on the craft before installation orientation can be sensed. This is evident from a plain reading of the claims. Therefore, this step *must* come after the installation step. L-3 argues that the installing and sensing step can be one and the same. (Def. Op. Brief page 26). The support cited from the specification proves L-3 wrong. L-3 cites to the passage that states “in the present embodiment, *upon* installation of the device ... the installation orientation is automatically measured... .” (‘018 Patent 4:7-10)(emphasis added). In other words, installation orientation is measured once the device has been installed. Avidyne does not suggest that these steps might not occur within rapid succession of each other but they do occur in succession.

- c. Element 3 (or 4 of claim 16): measuring an attitude of said mobile craft with said attitude determining device.

It is critical to remember that all an ADD does is measure its own attitude. (Dr. Kaplan’s expert report page 3 – Avidyne’s Op. Brief, Exhibit 3). It is when the ADD is properly aligned with a craft’s reference coordinate system that the attitude measurement of the ADD is equivalent to the attitude measurement of the craft. If the ADD is not installed on the craft then an attitude measurement of “said” craft with said attitude determining device is not possible. Therefore, at the very least, this measuring step must come after element 1 – the installing step.

The measuring step must also take place before the compensating step. The first clause in the compensating element is “compensating *said* craft attitude measurement...”. This necessarily requires that before the compensation is possible, the ADD must have derived said craft attitude measurement, that is, a measured attitude of the craft. That craft attitude measurement is only obtained upon completion of Element 3 (or 4 of claim 16). Therefore, the measuring step must occur after the first installation step and before the final compensation step. This is logical given what the ADD does. Because the ‘018 Patent teaches an installation of the ADD at an unknown orientation, the ADD is not aligned with the craft’s reference coordinate system and hence the attitude measurement must be compensated. As the measurement occurs before compensation, it is by definition a *pre*-compensated attitude measurement of the craft. Indeed, the addition of the prefix “pre” is not controversial as it merely summarizes what the claims require: that the measuring step produces an attitude measurement prior to the compensation step. (*Webster’s New Riverside Dictionary* at 537)(revised ed. 1996). Avidyne offered the prefix “pre” as a linguistic tool to distinguish the attitude measured in the measuring step from the compensated attitude resulting from the compensation step. If these two attitudes are one in the same, the compensating step has no function, making such a construction improper. *Flex-Rest, LLC v. Steelcase, Inc.*, 455 F.3d at 1361 citing *Warner-Jenkinson v. Hilton Davis Chem. Co.* 520 U.S. 17, 29 (1997).

L-3 again attempts to read out of existence one of the claim elements on page 26 of its Opening Markman Brief. There L-3 states “[i]n the case of the at rest craft, the disclosure discusses a sampling of the output of the acceleration sensors and determination by the processor in that would fulfill the measuring requirement of claims 1 and 16.” L-3 then references the specification at 4:38-40. This section of the specification is not clear in what it discloses, it is not

enabling, and is outside of the scope of the claims because the claim steps expressly refer back to the results of previous steps. As such, it is improper to rely on this small section of the specification to undermine the claim language. *Phillips*, 415 F.3d at 1312; citing *Vitronics Corp.*, 90 F.3d at 1582 (“we look to the words of the claims themselves ... to define the scope of the patented invention”); *Markman* 52 F.3d at 980 (the “specification itself cannot delimit the right to exclude. That is the function and purpose of claims”); *see also Network Commerce* 422 F.3d 1353 (Fed. Cir. 2005). In addition, L-3 argues that the passage they cite could relate to the measuring step but then fails to explain what the sensing step would comprise of. (Def. Op. Markman Brief page 26). L-3 cannot make claim elements inconsequential which constitutes another attempt to read claim elements out of existence. *Flex-Rest*, 455 F.3d at 1361.

- d. Element 4 (or 6 of claim 16): compensating said craft attitude measurement of said device with said static orientation measurement to obtain attitude information of said craft’s reference coordinate system with respect to said earth frame coordinate system.

This element requires the measuring and sensing step to be completed before this step can be performed because it expressly requires the results of the measuring step and the sensing step. The language specifically requires “said craft attitude measurement” and “said static orientation measurement” for the compensation process. This element refers to the *completed* results of elements 2 and 3 and not the process that derives those measurements. This compensation step requires the more precise *result* of the sensing step which is a static orientation measurement derived from the sensed installation orientation compared to earth frame when the craft is at rest. This is expressly defined in the sensing step. Similarly, the compensation step requires a craft attitude measurement – the *result* of the measuring step or element 3 (or element 4 of claim 16). The compensation step does not recite compensating while measuring an attitude. The words used in this compensation element are definitive and cannot work without the actual results of

step 2 (the sensing step) and step 3 (the measuring step): the static orientation measurement and the craft attitude measurement.

This detailed element analysis explains why L-3's position that the measuring and compensating steps can be one and the same is incorrect. The second reason is that L-3, as it has done with all previous elements, tries to read out of existence one of the claim elements. In this case it is the measurement step. (Def. Op. Markman Brief page 27 – 28). L-3 cites as support for this position the prosecution history. L-3 states that the inventor described to the PTO a method comprising of only three steps:

- 1) installing the attitude determining device at an unknown orientation...;
- 2) sensing the installation orientation while the craft is at rest to obtain a static orientation measurement of the device; and
- 3) compensating the craft attitude measurement of the device with the static orientation measurement. (Watson et. al. Response to the Office Action Dated October 9, 1997 Page 3 Prosecution History – Provided at Exhibit 1)

There are several problems with this argument. First, it undermines L-3 previous assertions that installing and sensing are the same process because it shows these as distinct steps here. It also negates the argument that sensing and/or measuring are the same because sensing is listed as its own step. Second, the Federal Circuit recognizes that the prosecution history may not necessarily be as helpful to claim construction as the issued patent. "Because the prosecution history represents an ongoing negotiation between the PTO and the applicant, rather than the final product of that negotiation, it often lacks the clarity of the specification and thus is less useful for claim construction purposes." *Phillips* 415 F.3d at 1317. Third, this three-element categorization is not convincing because craft attitude measurement is still described as a

completed calculation and so must be determined at some time previous to the third step. So, not only is the prosecution history not as conclusive as L-3 would have the Court believe, this argument is also inconsistent with L-3's preceding arguments. Most persuasively, arguments presented in the prosecution history cannot be used to eliminate expressly recited claim elements. *Phillips*, 415 F.3d at 1317; *Inverness Med. Switz. GmbH v. Warner Lambert Co.*, 309 F.3d 1373, 1380-82 (Fed. Cir. 2002); *Athletic Alternatives, Inc. v Prince Mfg., Inc.*, 73 F.3d 1573, 1580 (Fed. Cir. 1996). Significantly, this argument proffered by L-3 contradicts the claims which expressly recite 4 steps requiring completed results of the previous steps.

2. Specification

The specification also supports Avidyne's construction of the measuring step to be "processing the output of the sensors of the attitude determining device to determine a pre-compensated attitude of the mobile craft." As Avidyne explained at length in its opening brief, the specification teaches only one way to practice the '018 patent and that is in sequential order. (Pl. Op. Brief. Page 13-15). The Abstract and the Summary of the Invention recite the same order as the claims. Indeed, the specification does not describe the patent as being operable any other way. The Federal Circuit has held that in such instances, the claims should be construed in accordance with the only instruction the specification provides to practice the patent. *See generally Network Commerce*, 422 F.3d 1353; *Invitrogen Corp.*, 429 F.3d 1052. That necessarily means that the measuring step occurs before the compensation step so that the craft attitude measurement that results is by definition and teaching, a pre-compensated measurement.

3. Avidyne's Construction is Correct

Avidyne's construction as to the remainder of this term is also appropriate. The specification repeatedly describes the use of sensors and a processor as part of the ADD's

operation and are therefore required to produce a craft attitude measurement. For example consider this passage from the specification:

In accordance with the present invention, a method is described below which ensures an accurate calculation of the attitude of a moving craft, like an aircraft, for example, by measuring the installation orientation of the device 20 with respect to the reference coordinate axes of the aircraft and compensating for this orientation mathematically in a *processor of the device*. ('018 Patent 3:67-4:6)(emphasis added).

Considering the processor first, this paragraph provides no alternative to a compensation calculation performed by a "*processor of the device*." (emphasis added). *Id.* at 4:6 The entire patent does not provide any other alternative to a processor of the device performing the attitude calculation which first requires a pre-compensated attitude. The decision of *Cytec Corp.* is instructive on this point. The Court construed "displaying" and "visual display" as presenting on a computer screen because the specification suggested no alternative. The Court found that even though some of the references in the specification are to the preferred embodiment, as is the case of processor in the '018 Patent, "the written description still points towards a monitor as the only display mechanism." *Cytec Corp.*, 2005 U.S. Dist. LEXIS 29850 at . at *34. The Court continued by stating "the examples make clear that the patentee ... never doubted that the displays would be presented on a screen or monitor." *Id.* at *35. Similarly, the written description points to the processor as the only device that can process the output from the sensors and generate an attitude measurement from that data. Furthermore, the preferred embodiments and the figures make clear that the patentee never doubted that sensor data would be sent to the processor for the processor to generate attitude. L-3 invents the "computational device" in a lame attempt to "end run" the facts. (See Def. Op. Brief pgs. 35-36).

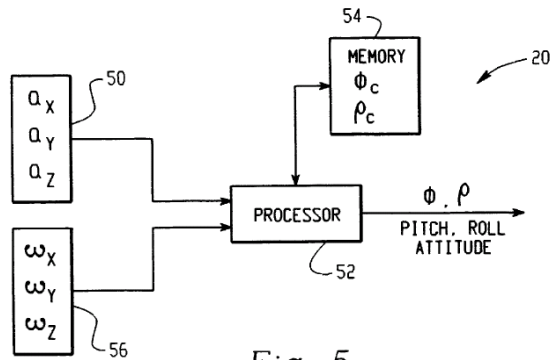


Fig. 5

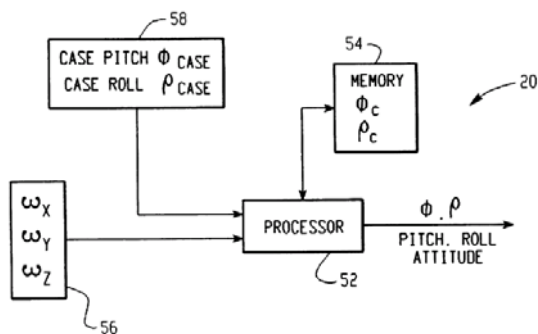


Fig. 6

For this reason, it is appropriate that the term “measuring an attitude of said mobile craft with said attitude determining device” necessarily include reference to the processors within the device.

The measuring step must also include reference to the sensors. The passage quoted above recites “measuring the installation orientation.” In the very next paragraph the specification states “[t]he installation orientation thereof is automatically measured by the installed device 20 and stored in a non-volatile memory thereof. For example, the pitch and roll are measured using the acceleration *sensors of the device*... . (emphasis added)(’018 Patent 4:10-14).” But consider this earlier statement:

The *internal acceleration sensors* ... determine the gravity vector Thereafter, rotational motion about the respective axes is sensed by the rate sensors, ... the output of which being integrated over time to maintain a real time craft attitude. ('018 Patent 3:25-30).

These are just a few passages which show that sensor output is necessary to determine the attitude measurement. The specification ties the processor and sensor functionality together by stating “[t]hese calculations are conventionally performed by a processor internal to the device which samples the sensor outputs and performs the initial and continuous algorithms to produce an attitude solution... .” ('018 Patent 3:35-40). The specification provides no other alternative to sensors supplying information to the processor to determine attitude. For all the foregoing reasons and consistent with the authority of *Cytac* and *Network Commerce*, Avidyne’s construction “processing the output of the sensors of the attitude determining device to determine a pre-compensated attitude of the mobile craft” is correct.

E. The Compensating Element of Claims 1 and 16

L-3 proposes that the compensating step of claim 1 should be interpreted to mean, “using the static orientation measurement to neutralize the craft attitude measurement for the installation orientation of the attitude determining device to obtain the orientation of the craft relative to the earth.” For claim 16, L-3 proposes “using the static orientation measurement data in an electronic computational device to neutralize the craft attitude measurement for the installation orientation of the attitude determining device to obtain an orientation of the craft relative to the earth.” L-3’s argument in favor of its compensating definition is misplaced, legally incorrect, and confusing.

1. Improper Reliance on the Preamble

L-3 relies exclusively on the preamble in advocating for a particular claim construction and then states that “‘compensating’ is to be interpreted consistently in the claims absent an

intent to interpret the term differently.”² Avidyne has already explained why the preamble does not constitute a limitation of this claim and the argument will not be repeated here.

2. Improper Reliance on Dictionary Definitions

L-3 conducts an improper claim construction analysis that is again contrary to recent Federal Circuit authority. L-3 starts with a dictionary definition of “compensating” and frames its argument around a broad abstract meaning of that term. The term L-3 has chosen – neutralize – appears in only one of the dictionaries that L-3 cites in its brief, the *Merriam-Webster’s Collegiate Dictionary*, despite relying on three different dictionaries in its opening brief. This is hardly convincing evidence that the ordinary meaning of the term compensating is neutralize when it is found in only one dictionary. L-3 then argues that “[i]t is error to deviate from this ordinary [dictionary] meaning which is consistent with the patent specification, since there is no clear directive in the specification to do so.” (Def. Op. Brief page 29). *Phillips* states that this approach is incorrect as it “improperly restricts the role of the specification in claim construction.” *Phillips*, 415 F.3d at 1320.

The Federal Circuit explained at length that “[t]he main problem with elevating the dictionary to such prominence is that it focuses the inquiry on the abstract meaning of words rather than on the meaning of claim terms within the context of the patent.” *Id.* at 1321. The Court continued by stating that “the ‘ordinary meaning’ of a claim term is its meaning to the ordinary artisan after reading the entire patent...” and “... heavy reliance on the dictionary divorced from the intrinsic evidence risks transforming the meaning of the claim term to the artisan into the meaning of the term in the abstract, out of its particular context, which is the specification.” *Id.* L-3 did just that: L-3 provides no context or meaning of the term

² Although, L-3 provides no legal basis for this statement, *Phillips* stands for this principle and Avidyne agrees. This same standard is true for the construction of the term attitude determining device where L-3’s argument as to the construction of that phrase is contrary to this legal standard on which they now rely.

“neutralize” but just throws it into their proposed definition hoping the Court will adopt a random and broad meaning of this compensating element. As the Federal Circuit has explained, this approach is legally incorrect. “[I]t is improper to read the term to encompass a broader definition simply because it may be found in a dictionary, treatise, or other extrinsic source.” *Nystrom*, 424 F.3d at 1145.

3. L-3 Proposes a Definition Divorced from the Actual Language of the Claims

The construction that L-3 proposes of this final element for both claims 1 and 16 is almost entirely divorced from what that claim element actually covers. First, L-3 includes the random word “neutralize”. The specification specifically makes clear that specific mathematical algorithms are required to perform the actual compensation. This math is described in column 3 and 4 of the ‘018 Patent. To characterize compensation as anything broader than that is contrary to *Phillips* and its progeny of case law specifically, *Nystrom*. L-3 then reinserts reference to “installation orientation” while also referring to static orientation measurement. To direct the Court’s attention back to the words of step 2 of claims 1 and 16 the static orientation measurement is *obtained* from the sensed installation orientation with respect to earth frame when the craft is at rest. With the static orientation measurement being the result, there is no longer a need for the constituent “installation orientation”. In addition, the result of this compensating step is to “obtain *attitude* information of said craft’s reference coordinate system” (emphasis added) but L-3 has reverted back to its old faithful – orientation. (‘018 Patent 6:7-10). In addition, earlier in its brief, L-3 advocated that orientation only refers to the ADD. (“[t]he specification consistently uses the term ‘orientation’ with regard to the attitude determining device.”) (Def. Op. Brief. Page 22). To now insert that word into the compensation element while referring to the craft relative to earth is inconsistent and confusing.

4. Avidyne's Proposed Construction is Correct

L-3 takes issue with Avidyne's position that the elements of claims 1 and 16 must be performed in sequential order. But this is a requirement of the claim language and to adopt any construction that does not reflect the express ordering of the steps is incorrect. This point has been explained at length in Avidyne's Opening Brief and also previously in this rebuttal brief. But consider again the exact language of element 4 of claim 1:

compensating *said craft attitude measurement* of said device with *said static orientation measurement* to obtain attitude information of said craft's reference coordinate system with respect to said earth frame coordinate system.

This claim element ties the previous steps into this claim by use of the word "said". This claim element does not recite what the constituent sub-parts are but expressly references the result of earlier steps. For example, a static orientation measurement is the result of the sensing step, as defined in the sensing step. Consider also claim 16. When the "storing" and "retrieving" steps are included in the method, they are not tacked on to the end of the claim elements, but rather inserted in a very specific order within the claim itself. These additional elements also refer back to previous steps. For example, "storing *said static orientation measurement* in a memory." And then "retrieving *said static orientation measurement* from *said* memory to a processor of said device" refers back to the stored static orientation resulting from the storing step. This language is consistent with the rest of the claim language and also with this method's order described in the specification, explained at length above. Avidyne's construction encompassing this teaching is correct and in accordance with the law. *Thorn EMI N. Am., Inc.*, 928 F. Supp. at 457; *Network Commerce* 422 F.3d 1353; *Invitrogen Corp. v. Clontech*, 429 F.3d 1052.

Finally, Avidyne preserves the specification's description that the compensation step be a mathematical calculation. For example, the specification at 4:47-50 states "the attitude of the craft 10 with respect to earth frame is determined by the processor 52 by subtracting these installation angles ... from the static angles of the device 20 with respect to earth frame." In light of the above, Avidyne's proposed construction of the compensating elements of claims 1 and 16 is clearly correct:

Claim 1: Applying said static orientation measurement (determined in said sensing step) to the pre-compensated attitude of the craft (determined in said measuring step) to mathematically correct the pre-compensated attitude of the craft (determined in said measuring step) by adjusting for the difference between that pre-compensated measured attitude of the craft and the craft's actual attitude relative to the earth frame.

Claim 16: Applying said retrieved static orientation measurement (determined in said sensing step) to the pre-compensated attitude of the craft (determined in said measuring step) in said processor to mathematically correct the pre-compensated attitude of the craft (determined in said measuring step) by adjusting for the difference between that pre-compensated measured attitude of the craft and the craft's actual attitude relative to earth.

F. Storing Said Static Orientation Measurement in a Memory.

Avidyne will accept L-3's definition of storing said static orientation measurement in a memory but with the addition of "memory" to accurately reflect the original claim language. The claim element should be construed as "retaining static orientation measurement data within a memory of the attitude determining device".

G. Retrieving Said Static Orientation Measurement from Said Memory to a Processor of Said Device.

L-3 offers a contrived interpretation of this element "providing static orientation measurement data to an electronic computational device within the attitude determining device.". The language of claim 16 clearly uses the word "processor" but L-3 offers "electronic

computational device” in its place. While the specification explains the need for a processor, it does not limit the processor to an electronic device. Avidyne maintains that the correct construction of this phrase is “obtaining the previously stored static orientation measurement from said memory and feeding it to the processor of the attitude determining device.”

IV. CONCLUSION

In light of Avidyne’s and L-3’s opening Markman briefs and the analysis contained within this rebuttal brief, Avidyne asks that the Court construe the disputed claim language as follows:

Disputed Claim Language	Proposed Construction of Disputed Terms
Attitude Determining Device	A device that includes sensors and a processor for processing the output of the sensors to determine attitude.
Sensing the installation orientation of said attitude determining device with respect to said earth frame coordinate system when said craft is at rest to obtain a static orientation measurement of said device.	Automatically determining the angular position of the installed attitude determining device relative to earth frame while the craft is not moving to obtain a static orientation measurement of the device.
Measuring an attitude of said mobile craft with said attitude determining device	Processing the output of the sensors of the attitude determining device to determine a pre-compensated attitude of the mobile craft.
Compensating said craft attitude measurement of said device with said static orientation measurement to obtain attitude information of said craft’s reference coordinate system with respect to said earth frame coordinate system.	Applying said static orientation measurement (determined in said sensing step) to the pre-compensated attitude of the craft (determined in said measuring step) to mathematically correct the pre-compensated attitude of the craft (determined in said measuring step) by adjusting for the difference between that pre-compensated measured attitude of the craft and the craft’s actual attitude relative to the earth frame.

Disputed Claim Language	Proposed Construction of Disputed Terms
Storing said static orientation measurement in memory	Retaining static orientation measurement data within a memory of the attitude determining device
Retrieving said static orientation measurement from said memory to a processor of said device.	Obtaining the previously stored static orientation measurement from said memory and feeding it to the processor of the attitude determining device.
Compensating said craft attitude measurement with said retrieved static orientation measurement in said processor to obtain attitude information of said craft's reference coordinate system with respect to said earth frame coordinate system.	Applying said retrieved static orientation measurement (determined in said sensing step) to the pre-compensated attitude of the craft (determined in said measuring step) in said processor to mathematically correct the pre-compensated attitude of the craft (determined in said measuring step) by adjusting for the difference between that pre-compensated measured attitude of the craft and the craft's actual attitude relative to earth.

Dated: October 16, 2006

Respectfully submitted,

AVIDYNE CORPORATION

By its attorneys,

/s/ Maia H. Harris

Jason C. Kravitz (BBO No. 565904)

Maia H. Harris (BBO No. 648208)

NIXON PEABODY LLP

100 Summer Street

Boston, MA 02110

(617) 345-1000

Frank W. Ryan (*admitted pro hac vice*)

Kate Cassidy (*admitted pro hac vice*)

NIXON PEABODY LLP

437 Madison Avenue

New York, NY 10022

(212) 940-3000

CERTIFICATE OF SERVICE

I hereby certify that on this 16th day of October, 2006, I caused a courtesy copy of the within document to be served via overnight mail on:

Terence J. Linn
Van Dyke, Gardner, Linn & Burkhart, LLP
Suite 207
2851 Charlevoix Drive S.E.
Grand Rapids, MI 49588-8695

/s/ Maia H. Harris
Maia H. Harris

EXHIBIT 1

73 Class 81 Subclass ISSUE CLASSIFICATION		UTILITY SERIAL NUMBER 007785553 PATENT DATE NOV 24 1998 PATENT NUMBER 285537		584 1018 	
SERIAL NUMBER 03/785,553	FILING DATE 12/13/96	CLASS 073	SUBCLASS 4981	GROUP ART UNIT 2214	EXAMINER Noori
APPLICANTS GARY S. WATSON, ADA, MI; KRISHNA DEVARASETTY, KENTWOOD, MI.					
CONTINUING DATA VERIFIED <i>MN</i> <i>None</i>					
FOREIGN/PCT APPLICATIONS VERIFIED <i>MN</i> <i>None</i>					
Foreign priority claimed 35 USC 119 conditions met <input type="checkbox"/> yes <input checked="" type="checkbox"/> no Verified and Acknowledged		AS FILED <input checked="" type="checkbox"/> yes <input type="checkbox"/> no	STATE OR COUNTRY MI	SHEETS, DRWGS. 4	TOTAL CLAIMS 20
			INDEP. CLAIMS 2	FILING FEE RECEIVED \$770.00	ATTORNEY'S DOCKET NO. 19A0150
ADDRESS THE B.F. GOODRICH COMPANY PATENT LAW DEPARTMENT 9921 BRECKSVILLE ROAD BRECKSVILLE OH 44141-3289			ISSUE FEE IN FILE		
TITLE METHOD OF COMPENSATING FOR INSTALLATION ORIENTATION OF AN ATTITUDE DETERMINING DEVICE ONBOARD A CRAFT					
U.S. DEPT. OF COMM./PAT. & TM--PTO-436L (Rev.12-9)					

PARTS OF APPLICATION FILED SEPARATELY		Applications Examiner	
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PREPARED FOR ISSUE		ISSUE BATCH NUMBER 697	
WARNING: The information disclosed herein may be restricted. Unauthorized disclosure may be prohibited by the United States Copyright Act, Title 17, Sections 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000.			

PATENT APPLICATION



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EXAMINATION & REVIEW

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|-----|--------------------------------|--------|---------------|
| 1. | Application | papers | |
| 2. | 45 Day Letter (3050) | | 3/12/97 |
| 3. | Stmnt (3050C) | | 4/2/97 |
| 4. | CR | | 4-4-97 |
| 5. | Prior Art | | March 3, 1997 |
| 6. | Petition | | 4-4-97 |
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US005841018A

United States Patent [19]

Watson et al.

[11] **Patent Number:** **5,841,018**[45] **Date of Patent:** **Nov. 24, 1998**

[54] **METHOD OF COMPENSATING FOR
INSTALLATION ORIENTATION OF AN
ATTITUDE DETERMINING DEVICE
ONBOARD A CRAFT**

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FOREIGN PATENT DOCUMENTS

[75] Inventors: **Gary Stewart Watson, Ada; Krishna
Devarasetty, Kentwood, both of Mich.**

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[73] Assignee: **B. F. Goodrich Avionics Systems, Inc.,
Akron, Ohio**

Primary Examiner—Max H. Noori
Attorney, Agent, or Firm—William E. Zitelli

[21] Appl. No.: **785,553**

[57] **ABSTRACT**

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[51] Int. Cl.⁶ **G01C 17/38; G01C 21/00**

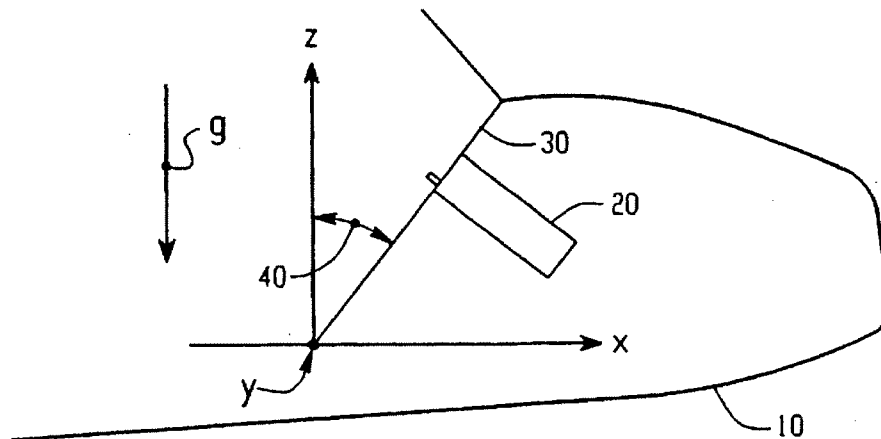
[52] U.S. Cl. **73/1.81; 73/178 R; 244/164**

[58] Field of Search **73/1.79, 1.81,
73/1.78, 1.75, 1.76, 1.77, 178 R; 244/164,
171**

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In accordance with the disclosed method, an attitude determining device which is installed onboard a mobile craft, like an aircraft, for example, at an unknown orientation with respect to the reference coordinate system of the craft senses its installation orientation with respect to an earth frame coordinate system when the craft is at rest to obtain a static orientation measurement thereof. Thereafter, an attitude of the mobile craft with respect to the earth frame is measured with the attitude determining device and such measurement is compensated with the static orientation measurement to obtain attitude information of the craft's reference coordinate system with respect to the earth frame coordinate system. The installation orientation of the attitude determining device may be sensed while the craft is at rest in either a leveled or unleveled condition.

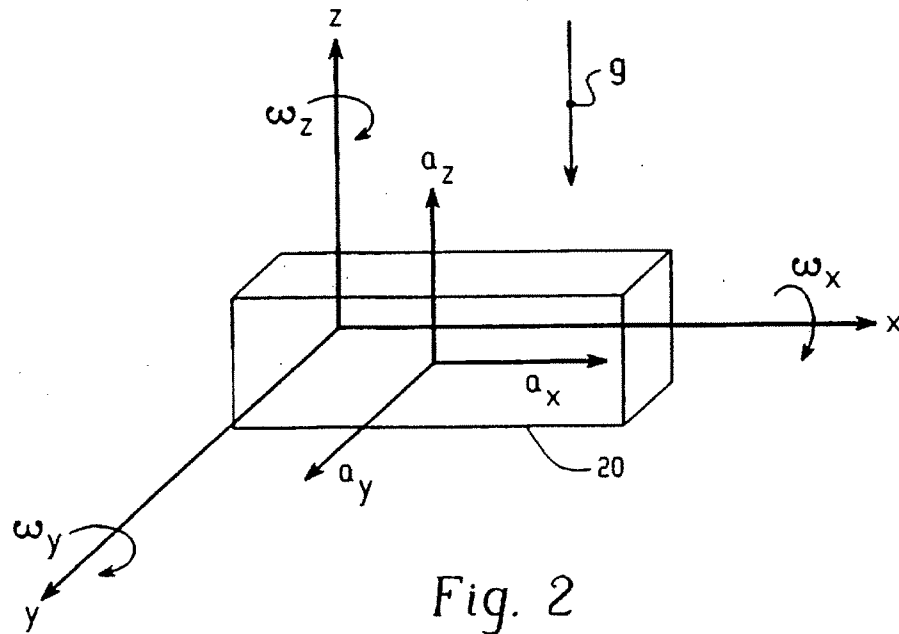
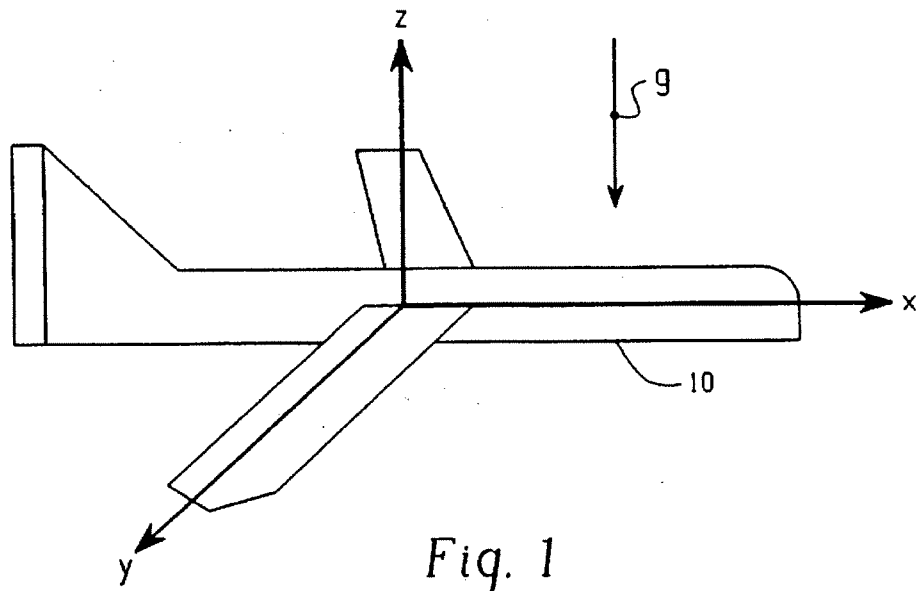
20 Claims, 4 Drawing Sheets

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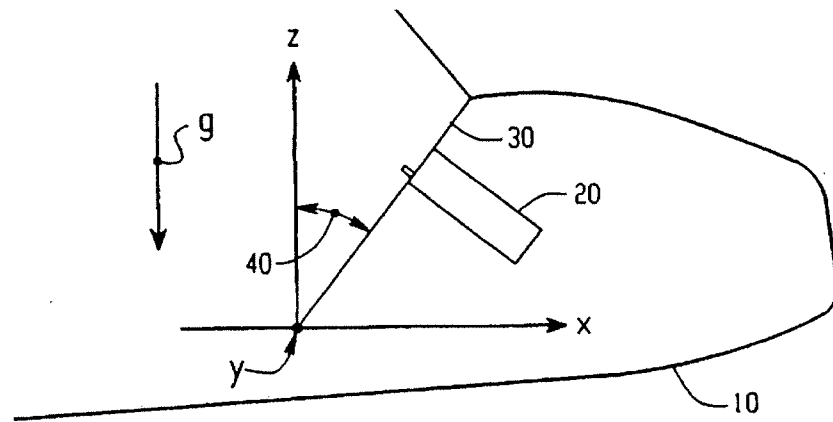


Fig. 3

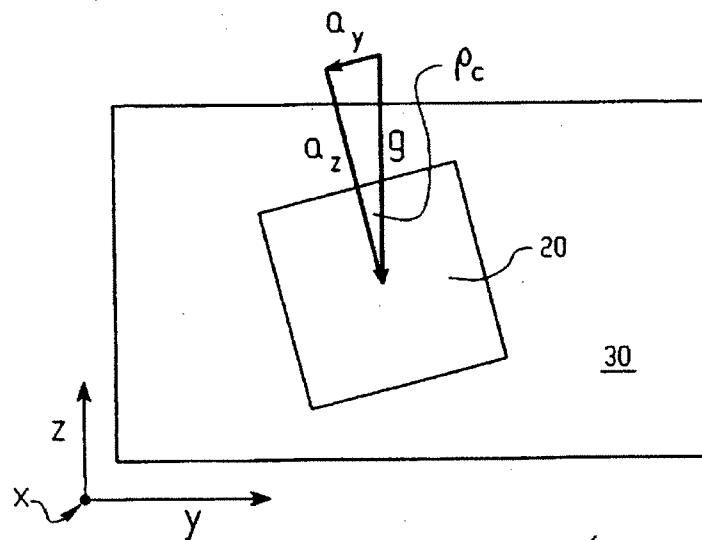


Fig. 4A

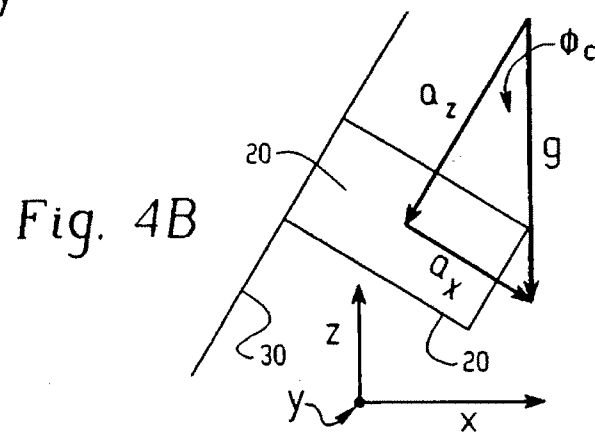


Fig. 4B

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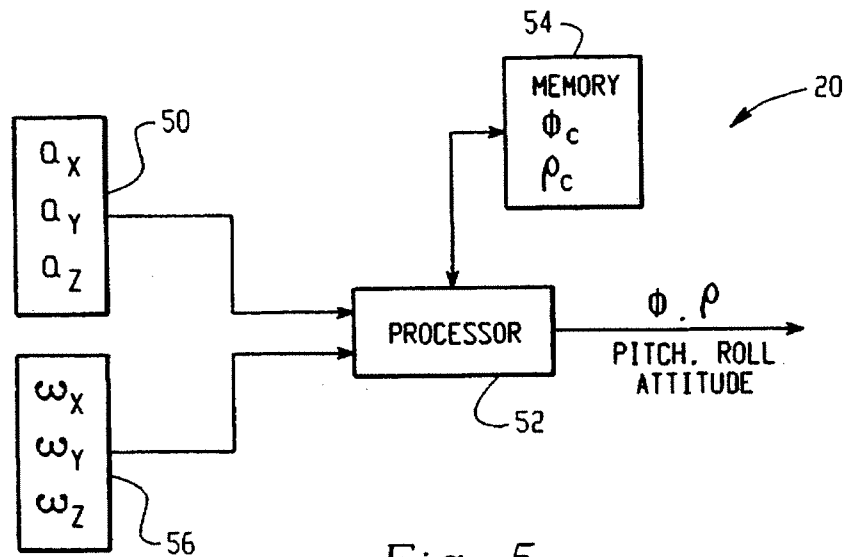


Fig. 5

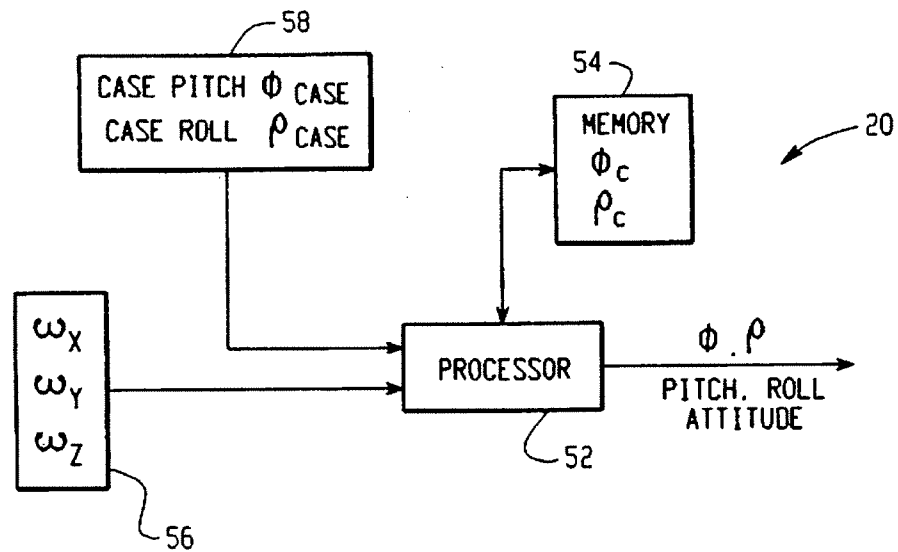


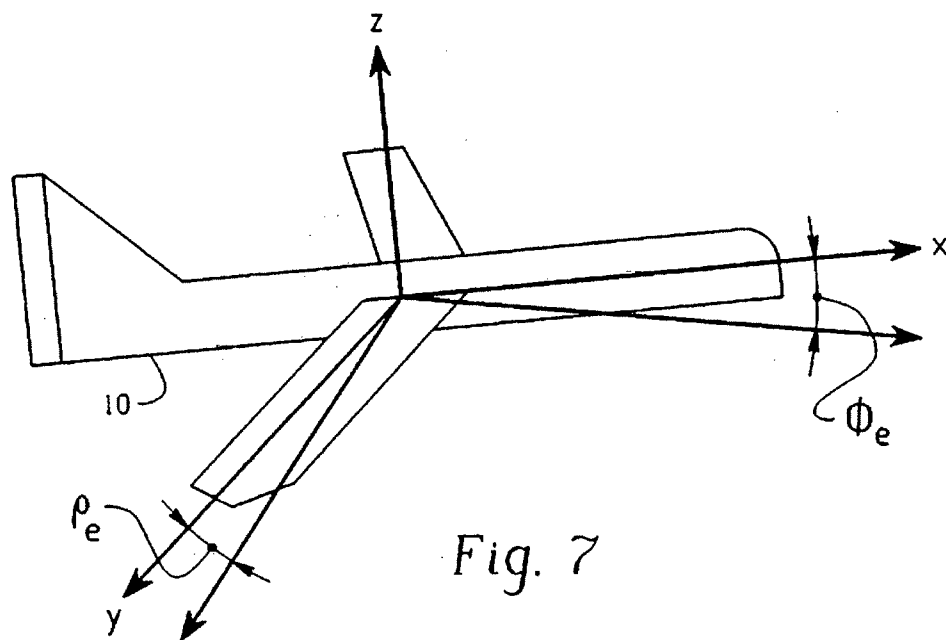
Fig. 6

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METHOD OF COMPENSATING FOR INSTALLATION ORIENTATION OF AN ATTITUDE DETERMINING DEVICE ONBOARD A CRAFT

BACKGROUND OF THE INVENTION

The present invention relates to attitude determining devices onboard a mobile craft for determining the attitude of the craft's reference coordinate system with respect to an earth frame of reference, and more specifically, to a method of compensating an attitude measurement of such device for an unknown installation orientation with respect to the reference coordinate system of the craft.

Attitude determining devices for mobile craft, like aircraft, for example, measure the attitude of the moving craft with respect to an outside reference coordinate system, typically known as earth frame. The devices may be installed at a location in the craft in such a manner to be mechanically aligned with the reference coordinate system of the craft. The reference coordinate system of conventional aircraft comprises three orthogonal axes which include a longitudinal or X axis, a lateral or Y axis, and a vertical or Z axis. Motion of the aircraft is generally described as roll which is a rotation about the X axis, pitch which is a rotation about the Y axis and yaw which is a rotation about the Z axis. Pitch, roll and yaw positions are measured as the current angle between the aircraft reference coordinate system and earth frame. Conventionally, aircraft attitude determining devices primarily measure attitude of the aircraft in pitch and roll.

Any inaccuracy in installing an attitude determining device in the craft with respect to the reference coordinate system thereof will result in inaccurate measurement and presentation of the attitude of the craft to either the pilot or other system using the attitude information for display or control purposes. Currently, a method of installing these devices in an aircraft has been to accurately level the aircraft first, and then, install the device using shims or other mechanical apparatus to correctly position the device with respect to the three orthogonal axes forming the coordinate system of the aircraft. This procedure of leveling is adequate for devices mounted in locations of the aircraft remote from the cockpit, but when the device is to be mounted in a cockpit location, such as on an instrument panel, for example, shimming or other mechanical means of adjusting the installation orientation thereof may be precluded due to viewing angle restrictions, aesthetics, . . . etc. Accordingly, some other compensation method will be required.

Currently, units installed on an instrument panel in the cockpit of an aircraft have slots for roll axis alignment and internal mechanical means to accommodate pitch angles other than zero. However, these accommodations for pitch angles make the assumption of zero error in manufacturing tolerances of the aircraft panel angle.

Accordingly, the inventive method described herein below ensures a substantially accurate measurement of aircraft attitude by the attitude determining device with respect to the earth frame of reference. The static installation orientation is automatically determined by the device itself and the attitude measurement is compensated therewith in a processor of the device. Thus, the drawbacks of the current mechanical leveling and alignment procedures are avoided.

SUMMARY OF THE INVENTION

In accordance with the present invention, an attitude determining device which is installed onboard a mobile craft

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at an unknown orientation with respect to the reference coordinate system of the craft senses its installation orientation with respect to an earth frame coordinate system when the craft is at rest to obtain a static orientation measurement.

An attitude of the mobile craft is measured with the attitude determining device and such measurement is compensated with the static orientation measurement to obtain attitude information of the craft's reference coordinate system with respect to the earth frame coordinate system.

In one embodiment, the acceleration of the attitude determining device is sensed for each of the axes of the reference coordinate system of the mobile craft while at rest and leveled, and a static attitude pitch and static attitude roll of the device are determined from trigonometric functions of ratios of the sensed accelerations. Accordingly, both of the measured attitude pitch and roll of the device are compensated with the static attitude pitch and the static attitude roll, respectively, in the attitude determining device to render attitude information of the craft's reference coordinate system with respect to the earth frame coordinate system.

In another embodiment, a static attitude of the mobile craft in pitch and roll is obtained while the craft is at rest and unleveled. Thereafter, the static attitude craft pitch is used in determining the static attitude pitch of the device and the static attitude craft roll is used in determining the static attitude roll of the device and such static attitude pitch and roll are used respectively to compensate for the measured attitude pitch and roll of the mobile craft in the attitude determining device.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an illustration of an aircraft, with its reference coordinate system, onboard which an attitude determining device may be installed.

FIG. 2 is an illustration of an attitude determining device including conventional internal acceleration and rate sensors for three orthogonal axes X, Y and Z.

FIG. 3 is a sketch of an attitude determining device mounted on a panel in the cockpit of an aircraft at an unknown orientation to the reference coordinate system of the craft.

FIGS. 4A and 4B are illustrations exemplifying methods of determining the pitch and roll of the attitude determining device onboard a mobile craft using sensed acceleration measurements of the device in accordance with the present invention.

FIG. 5 is a block diagram schematic representing a suitable embodiment of an attitude determining device for performing the method in accordance with the present invention.

FIG. 6 is a block diagram schematic representing an alternate embodiment of an attitude determining device for performing another aspect of the present invention.

FIG. 7 is an illustration of an aircraft having its reference coordinate system unleveled with respect to an earth frame coordinate system allowing for offset angles of pitch and roll respectively from a level attitude.

DESCRIPTION OF THE PREFERRED EMBODIMENT

For the present embodiment, an aircraft will be used, by way of example, as a mobile craft, but it is understood that other similar craft may be used where ever an attitude of the craft is desired and measured with respect to an earth frame of reference coordinate system, hereinafter referred to sim-

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ply as earth frame. An aircraft with its reference coordinate system is shown in FIG. 1 including a longitudinal axis depicted as an X axis, a lateral axis depicted as a Y axis, and a vertical axis depicted as a Z axis. Accordingly, roll of the aircraft may be measured as the angular rotation about the X axis, pitch of the aircraft may be measured by the angular rotation about the Y axis and yaw of the aircraft may be measured by the angular rotation about the vertical Z axis. All of these angles are measured with respect to the earth frame. Conventionally, an attitude determining device of an aircraft measures attitude in pitch and roll.

To accurately level the aircraft 10 such that its reference coordinate axes coincides with earth frame, the aircraft is adjusted in attitude such that an acceleration a_z sensed for the Z axis is set substantially equal to a gravity vector g , and the accelerations sensed in the X axis, a_x and in the Y axis, a_y , are set substantially to zero. When these conditions are sensed and stabilized, the aircraft 10 is considered leveled.

FIG. 2 is an illustration of an attitude determining device 20 which may include conventional internal acceleration sensors for the three orthogonal axes X, Y and Z, and may also include conventional rate sensors to measure the rotational motion ω_x , ω_y , and ω_z which are the rotational motions about the respective axes X, Y and Z. An example of such a device is an inertial reference unit manufactured by Honeywell, Inc., model no. HG2001AB02. The internal acceleration sensors (not shown) determine the gravity vector or local vertical g . Thereafter, rotational motion about the respective axes X, Y and Z is sensed by the rate sensors (also not shown), the output of which being integrated over time to maintain a real time craft attitude. Any accumulated integration errors may be removed during static periods by re-aligning the derived output of the device to the local vertical g which procedure is referred to as leveling or erection. These calculations are conventionally performed by a processor internal to the device which samples the sensor outputs and performs the initial and continuous algorithms to produce an attitude solution to be used for display in the aircraft or for a guidance and/or control application for the aircraft.

The attitude determining device 20 may be of a strap down system which is mechanically mounted to the case of the device or a gimbaled instrument having elements which are free to rotate in inertial space independent of the case of the unit. In either case, in locating the attitude determining device 20 on board a moving craft, like an aircraft, for example, it may be installed at an unknown orientation with respect to the reference coordinate system of the craft which in the present embodiment are the three orthogonal axes X, Y and Z. It is desired that the device be mounted level with the lateral and longitudinal axes of the craft and aligned with the longitudinal X axis such as shown in FIG. 2, but this may not always be possible due to errors in mechanical leveling or adjusting of the orientation and due to errors in manufacturing tolerances of the device and the aircraft structure where the device is being mounted. This is especially evident when the attitude determining device 20 is mounted on a panel in the cockpit of the aircraft 10 much as illustrated in the sketch of FIG. 3.

Referring to FIG. 3, when the attitude determining device 20 is installed on an aircraft instrument panel 30, the device may not be aligned with the "waterline" or level line of the aircraft in order to compute accurate attitude information. This is because the panel is often not perpendicular to the waterline and it is not possible in most cases to exactly compensate mechanically for the panel angle offset 40 to the vertical or Z axis. In accordance with the present invention,

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a method is described below which ensures an accurate calculation of the attitude of a moving craft, like an aircraft, for example, by measuring the installation orientation of the device 20 with respect to the reference coordinate axes of the aircraft and compensating for this orientation mathematically in a processor of the device 20.

In the present embodiment, upon installation of the device 20 on the instrumentation panel 30 of the craft 10, whose reference coordinate axes have been leveled to coincide with earth frame, the installation orientation thereof is automatically measured by the installed device 20 and stored in a non-volatile memory thereof. For example, the pitch, ϕ_c and the roll, ρ_c are measured using the acceleration sensors of the device 20 and this measurement is exemplified by the illustrations of FIGS. 4A and 4B. In FIG. 4A, the panel 30 and mounted device 20 is shown in the plane of the axes Z and Y to describe the measurement of the roll angle ρ_c of the installed device 20. In the plane of the axes Z and Y, the acceleration vectors a_y and a_z are added vectorially to yield the gravity vector g . The installation roll angle ρ_c about the X axis is the angle between the vectors g and a_z and may be determined mathematically in accordance with a trigonometric function of the ratio of a_y to a_z .

Similarly, the perspective of the device 20 installed on the panel 30 in the plane of the axes X and Z is shown in FIG. 4B. Referring to FIG. 4B, in this perspective, the acceleration vectors a_x and a_z add up vectorially to yield the gravity vector g and the pitch angle ϕ_c is the angle between the vectors g and a_z which is a rotation about the Y axis. The installation pitch angle ϕ_c may be determined mathematically in accordance with a trigonometric function of the ratio of a_x to a_z . In the present embodiment, the trigonometric function used for determining the installed roll and pitch angles for static orientation of the device 20 is the arcsine.

A block diagram schematic representing a suitable embodiment of the attitude determining device is shown in FIG. 5. Referring to FIG. 5, after the device is installed on the instrument panel of a leveled craft 10, for example, and power is subsequently activated to the device 20, an internal processor 52 of the device 20 samples the outputs of the acceleration sensors depicted in the block 50 in all three axes a_x, a_y, a_z . The static angles of the device 20 with respect to earth frame are determined by the processor 52 from the static acceleration measurements based on the trigonometric function described above. The installation angles ϕ_c and ρ_c are read from non-volatile memory 54 of the device 20 and the attitude of the craft 10 with respect to earth frame is determined by the processor 52 by subtracting these installation angles ϕ_c and ρ_c from the static angles of the device 20 with respect to earth frame. Thereafter, the pitch and roll attitude angles of the moving craft 10 are computed conventionally by the processor 52 via the rate sensors $\omega_x, \omega_y, \omega_z$ which are shown at block 56 of the device 20 and received by the processor 52. In a gimbaled attitude determining device the angles of the spin axis, measured using synchros or other such devices, with respect to the case are corrected by subtracting the installation angles ϕ_c and ρ_c to yield actual aircraft pitch and roll attitude angles.

In summary, for the case in which the craft is leveled according to the description supplied above prior to sensing the installation orientation of device 20, the processor 52 samples the outputs a_x, a_y and a_z of the acceleration sensors 50. The static installation angles ϕ_c and ρ_c are determined by the processor 52 from the static acceleration measurements based on the trigonometric function described above and are stored in a non-volatile memory 54 for use in compensating the attitude measurements with respect to earth frame.

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Power to device 20 may then be removed. Subsequent power application to device 20 would allow a measurement of the attitude of the aircraft, i.e. orientation of the aircraft's reference coordinate axes with respect to earth frame, to be correctly determined by processor 52 using ϕ_c and ρ_c from the memory 54.

In some applications, the attitude determining device 20 may not include acceleration sensors 50 but rather include level sensors for sensing directly the pitch ϕ_{case} and roll ρ_{case} of the installed case with respect to the earth frame. A block diagram schematic suitable for exemplifying an alternate embodiment of the device 20 including level sensors is shown in FIG. 6 with the level sensing depicted at 58. Like reference numerals are given to the other elements of the device 20 to match those described in connection with the embodiment of FIG. 5. In operation, the processor receives the installation orientation angles ϕ_{case} and ρ_{case} measured by the level sensors at 58 and stores them in the non-volatile memory 54 as ϕ_c and ρ_c to be accessed subsequently in compensating for the attitude angle measurements as described in connection with the embodiment of FIG. 5.

The foregoing method provides for compensating for the installation orientation of the device 20 for a leveled craft. If the craft 10 is not in a level attitude as shown in the exemplified illustration of FIG. 7, the actual unlevel aircraft attitude may be measured i.e. reference coordinate axes of the aircraft with respect to earth frame, allowing the processor 52 to determine the offset angles of pitch and roll, ϕ_p and ρ_p , respectively, from a level attitude. These pitch and roll angle offsets from a level condition of the aircraft may be input either manually or electrically to the processor 52 of the device 20 as shown in FIGS. 5 and 6. In addition, the static installation angles are measured by device 20 with respect to the unlevelled aircraft coordinate axes. In order for the processor 52 of device 20 to calculate the effective static installation pitch and roll angles, ϕ_e and ρ_e of the case with respect to a level reference coordinate system of the craft 10, it may subtract the measured offset angles from their respective measured installation angles. The effective static orientation measurements of the case with respect to the craft's reference coordinate system may then be stored in the memory 54 as shown in FIGS. 5 and 6 in order to compensate for the installation orientation of the device in the craft 10 as described supra.

In attitude determining devices in which there is no non-volatile memory, the step of sensing the installation orientation of the device to obtain a static orientation measurement with respect to the reference coordinate system of the craft may be performed each time the power is turned on and the aircraft is in a static condition. The resulting static orientation measurement may be stored in the memory of the device for use in compensating for attitude measurements for the moving craft.

While the invention has been described herein in connection with a preferred embodiment, it should not be so limited, but rather construed in accordance with the breadth and broad scope of the claim set appended hereto.

We claim:

1. A method of compensating for installation orientation of an attitude determining device on-board a mobile craft with respect to a reference coordinate system of said craft to obtain attitude information of said craft from said device based on an earth frame coordinate system, said method comprising the steps of:

installing said attitude determining device on-board said mobile craft at an unknown orientation with respect to said reference coordinate system of said craft;

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sensing the installation orientation of said attitude determining device with respect to said earth frame coordinate system when said craft is at rest to obtain a static orientation measurement of said device;

measuring an attitude of said mobile craft with said attitude determining device; and

compensating said craft attitude measurement of said device with said static orientation measurement to obtain attitude information of said craft's reference coordinate system with respect to said earth frame coordinate system.

2. The method in accordance with claim 1 wherein the reference coordinate system of said craft includes three orthogonal axes—a vertical or z axis, a longitudinal or x axis and a lateral or y axis.

3. The method in accordance with claim 2 wherein the step of sensing includes:

leveling the craft while at rest such that the z axis is aligned with a gravity vector and no substantial at rest acceleration exists at the x and y axes;

sensing the acceleration at the device for each of said three axes—a(x), a(y) and a(z) while the craft is at rest and leveled; and

determining the static orientation measurement of said device based on a function of said three sensed axis accelerations—a(x), a(y) and a(z).

4. The method in accordance with claim 3 wherein the step of determining includes:

determining a static attitude pitch of the device as a trigonometric function of a ratio of the sensed accelerations a(x) and a(z); and

determining a static attitude roll of the device as a trigonometric function of a ratio of the sensed accelerations a(y) and a(z); and

wherein the static orientation measurement of the device comprises the determined static attitude pitch and static attitude roll.

5. The method in accordance with claim 4 wherein the step of measuring includes measuring an attitude pitch and an attitude roll of the mobile craft with said device; and the step of compensating includes compensating the measured attitude pitch with the static attitude pitch and compensating the measured attitude roll with the static attitude roll.

6. The method in accordance with claim 2 wherein the step of sensing includes:

sensing the acceleration at the device for each of said three axes—a(x), a(y) and a(z) while the craft is at rest and unlevelled;

obtaining a static attitude of the craft while at rest and unlevelled;

determining the static orientation measurement of said device based on said static craft attitude and a function of said three sensed axis accelerations—a(x), a(y) and a(z).

7. The method in accordance with claim 6 wherein the step of obtaining includes:

obtaining a static craft pitch and a static craft roll; and the step of determining includes:

determining a static attitude pitch of the device as a trigonometric function of a ratio of the sensed accelerations a(x) and a(z) and said static craft pitch; and determining a static attitude roll of the device as a trigonometric function of a ratio of the sensed accelerations a(y) and a(z) and said static craft roll; and wherein the static orientation measurement of the device comprises the determined static attitude pitch and static attitude roll.

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8. The method in accordance with claim 7 wherein the step of measuring includes measuring an attitude pitch and an attitude roll of the mobile craft with said device; and the step of compensating includes compensating the measured attitude pitch with the static attitude pitch and compensating the measured attitude roll with the static attitude roll.

9. The method in accordance with claim 1 wherein the step of sensing includes:

leveling the craft while at rest;

sensing an installation pitch and an installation roll of the device while the craft is at rest and leveled; and

wherein the static orientation measurement of the device comprises the sensed installation pitch and roll of the device.

10. The method in accordance with claim 9 wherein the step of measuring includes measuring an attitude pitch and an attitude roll of the mobile craft with said device; and the step of compensating includes compensating the measured attitude pitch with the sensed installation pitch and compensating the measured attitude roll with the sensed installation roll.

11. The method in accordance with claim 1 wherein the step of sensing includes:

sensing an installation pitch and an installation roll of the device while the craft is at rest and unleveled;

obtaining a static attitude pitch and a static attitude roll of the craft while at rest and unleveled;

determining a static attitude pitch of said device based on a combination of said static craft attitude pitch and said installation pitch and a static attitude roll of the device based on a combination of said static craft attitude roll and said installation roll;

wherein the static orientation measurement of the device comprises the determined static device attitude pitch and static device attitude roll.

12. The method in accordance with claim 11 wherein the step of measuring includes measuring an attitude pitch and an attitude roll of the mobile craft with said device; and the step of compensating includes compensating the measured attitude pitch with the static device attitude pitch and compensating the measured attitude roll with the static device attitude roll.

13. The method in accordance with claim 1 wherein the mobile craft is an aircraft, and the attitude device is installed on an instrumentation panel of said aircraft.

14. The method in accordance with claim 1 wherein the attitude determining device comprises a strapdown attitude instrument.

15. The method in accordance with claim 1 wherein the attitude determining device comprises a gimbaled attitude instrument.

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16. A method of compensating for installation orientation of an attitude determining device on-board a mobile craft with respect to a reference coordinate system of said craft to obtain attitude information of said craft from said device based on an earth frame coordinate system, said method comprising the steps of:

installing said attitude determining device on-board said mobile craft at an unknown orientation with respect to said reference coordinate system of said craft;

sensing the installation orientation of said attitude determining device with respect to said earth frame coordinate system when said craft is at rest to obtain a static orientation measurement of said device;

storing said static orientation measurement in a memory; measuring an attitude of said mobile craft with said attitude determining device;

retrieving said static orientation measurement from said memory to a processor of said device; and

compensating said craft attitude measurement with said retrieved static orientation measurement in said processor to obtain attitude information of said craft's reference coordinate system with respect to said earth frame coordinate system.

17. The method in accordance with claim 16 wherein the step of sensing includes:

sensing the installation orientation of the device with sensors disposed at the device;

receiving in the processor sensed orientation data of said sensors; and

processing the received data in the processor to obtain the static orientation measurement of the device.

18. The method in accordance with claim 17 wherein the step of sensing includes sensing the installation orientation of the device with acceleration sensors.

19. The method in accordance with claim 17 wherein the step of sensing includes sensing the installation orientation of the device with level sensors.

20. The method in accordance with claim 16 wherein the step of compensating includes:

obtaining a static attitude of the craft while at rest and unleveled;

providing said static craft attitude to the processor of said device; and

compensating said craft attitude measurement with said retrieved static orientation measurement and static craft attitude in said processor to obtain attitude information of the craft's reference coordinate system with respect to the earth frame coordinate system.

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PATENT
Docket No. 1960053Assistant Commissioner of Patents
Washington, D.C. 20231

Sir:

TRANSMITTED HERewith FOR FILING IS THE PATENT APPLICATION OF

INVENTOR(S): Gary Stewart Watson and Krishna Devarsaetty

FOR: **A METHOD OF COMPENSATING FOR INSTALLATION ORIENTATION
OF AN ATTITUDE DETERMINING DEVICE ONBOARD A CRAFT**

ENCLOSED ARE:

- [X] Specification and Claims
- [X] 4 Sheets of Informal Drawings
- [X] Combined Declaration and Power of Attorney
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TOTAL:				\$770.

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The B.F. Goodrich Company
9921 Brecksville Road
Brecksville, Ohio 44141-3289
Telephone: (216) 447-5921

William E. Zitelli
William E. Zitelli
Attorney of Record
Reg. No. 28,551

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Title: A METHOD OF COMPENSATING FOR INSTALLATION
ORIENTATION OF AN ATTITUDE DETERMINING DEVICE
ONBOARD A CRAFT

BACKGROUND OF THE INVENTION

The present invention relates to attitude determining devices onboard a mobile craft for determining the attitude of the craft's reference coordinate system with respect to an earth frame of reference, and more specifically, to a method of compensating an attitude measurement of such device for an unknown installation orientation with respect to the reference coordinate system of the craft.

Attitude determining devices for mobile craft, like aircraft, for example, measure the attitude of the moving craft with respect to an outside reference coordinate system, typically known as earth frame. The devices may be installed at a location in the craft in such a manner to be mechanically aligned with the reference coordinate system of the craft.

The reference coordinate system of conventional aircraft comprises three orthogonal axes which include a longitudinal or X axis, a lateral or Y axis, and a vertical or Z axis. Motion of the aircraft is generally described as roll which is a rotation about the X axis, pitch which is a rotation about the Y axis and yaw which is a rotation about the Z axis. Pitch, roll and yaw positions are measured as the current angle between the aircraft reference coordinate system and earth frame. Conventionally, aircraft attitude determining devices primarily measure attitude of the aircraft in pitch and roll.

Any inaccuracy in installing an attitude determining device in the craft with respect to the reference coordinate system thereof will result in inaccurate measurement and presentation of the attitude of the craft to either the pilot or other system using the attitude information for display or control purposes. Currently, a method of installing these

devices in an aircraft has been to accurately level the aircraft first, and then, install the device using shims or other mechanical apparatus to correctly position the device with respect to the three orthogonal axes forming the coordinate system of the aircraft. This procedure of leveling is adequate for devices mounted in locations of the aircraft remote from the cockpit, but when the device is to be mounted in a cockpit location, such as on an instrument panel, for example, shimming or other mechanical means of adjusting the installation orientation thereof may be precluded due to viewing angle restrictions, aesthetics, ...etc. Accordingly, some other compensation method will be required.

Currently, units installed on an instrument panel in the cockpit of an aircraft have slots for roll axis alignment and internal mechanical means to accommodate pitch angles other than zero. However, these accommodations for pitch angles make the assumption of zero error in manufacturing tolerances of the aircraft panel angle.

Accordingly, the inventive method described herein below ensures a substantially accurate measurement of aircraft attitude by the attitude determining device with respect to the earth frame of reference. The static installation orientation is automatically determined by the device itself and the attitude measurement is compensated therewith in a processor of the device. Thus, the drawbacks of the current mechanical leveling and alignment procedures are avoided.

Summary of The Invention

In accordance with the present invention, an attitude determining device which is installed onboard a mobile craft at an unknown orientation with respect to the reference coordinate system of the craft senses its installation orientation with respect to an earth frame coordinate system when the craft is at rest to obtain a static orientation measurement. An attitude of the mobile craft is measured with

the attitude determining device and such measurement is compensated with the static orientation measurement to obtain attitude information of the craft's reference coordinate system with respect to the earth frame coordinate system.

5 In one embodiment, the acceleration of the attitude determining device is sensed for each of the axes of the reference coordinate system of the mobile craft while at rest and leveled, and a static attitude pitch and static attitude roll of the device are determined from trigonometric functions
10 of ratios of the sensed accelerations. Accordingly, both of the measured attitude pitch and roll of the device are compensated with the static attitude pitch and the static attitude roll, respectively, in the attitude determining device to render attitude information of the craft's reference
15 coordinate system with respect to the earth frame coordinate system.

In another embodiment, a static attitude of the mobile craft in pitch and roll is obtained while the craft is at rest and unleveled. Thereafter, the static attitude craft pitch is
20 used in determining the static attitude pitch of the device and the static attitude craft roll is used in determining the static attitude roll of the device and such static attitude pitch and roll are used respectively to compensate for the measured attitude pitch and roll of the mobile craft in the
25 attitude determining device.

Brief Description of the Drawings

Fig. 1 is an illustration of an aircraft, with it's reference coordinate system, onboard which an attitude determining device may be installed.

30 Fig. 2 is an illustration of an attitude determining device including conventional internal acceleration and rate sensors for three orthogonal axes X, Y and Z.

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Fig. 3 is a sketch of an attitude determining device mounted on a panel in the cockpit of an aircraft at an unknown orientation to the reference coordinate system of the craft.

Figures 4A and 4B are illustrations exemplifying methods of determining the pitch and roll of the attitude determining device onboard a mobile craft using sensed acceleration measurements of the device in accordance with the present invention.

Fig. 5 is a block diagram schematic representing a suitable embodiment of an attitude determining device for performing the method in accordance with the present invention.

Fig. 6 is a block diagram schematic representing an alternate embodiment of an attitude determining device for performing another aspect of the present invention.

Fig. 7 is an illustration of an aircraft having its reference coordinate system unlevelled with respect to an earth frame coordinate system allowing for offset angles of pitch and roll respectively from a level attitude.

20 DESCRIPTION OF THE PREFERRED EMBODIMENT

For the present embodiment, an aircraft will be used, by way of example, as a mobile craft, but it is understood that other similar craft may be used where ever an attitude of the craft is desired and measured with respect to an earth frame of reference coordinate system, hereinafter referred to simply as earth frame. An aircraft with its reference coordinate system is shown in Fig. 1 including a longitudinal axis depicted as an X axis, a lateral axis depicted as a Y axis, and a vertical axis depicted as a Z axis. Accordingly, roll of the aircraft may be measured as the angular rotation about the X axis, pitch of the aircraft may be measured by the angular rotation about the Y axis and yaw of the aircraft may be measured by the angular rotation about the vertical Z axis. All of these angles are measured with respect to the earth

frame. Conventionally, an attitude determining device of an aircraft measures attitude in pitch and roll.

To accurately level the aircraft 10 such that its reference coordinate axes coincides with earth frame, the aircraft is adjusted in attitude such that an acceleration a_z sensed for the Z axis is set substantially equal to a gravity vector g , and the accelerations sensed in the X axis, a_x , and in the Y axis, a_y , are set substantially to zero. When these conditions are sensed and stabilized, the aircraft 10 is considered leveled.

Fig. 2 is an illustration of an attitude determining device 20 which may include conventional internal acceleration sensors for the three orthogonal axes X, Y and Z, and may also include conventional rate sensors to measure the rotational motion ω_x , ω_y , and ω_z which are the rotational motions about the respective axes X, Y and Z. An example of such a device is an inertial reference unit manufactured by Honeywell, Inc., model no. HG2001AB02. The internal acceleration sensors (not shown) determine the gravity vector or local vertical g . Thereafter, rotational motion about the respective axes X, Y and Z is sensed by the rate sensors (also not shown), the output of which being integrated over time to maintain a real time craft attitude. Any accumulated integration errors may be removed during static periods by re-aligning the derived output of the device to the local vertical g which procedure is referred to as leveling or erection. These calculations are conventionally performed by a processor internal to the device which samples the sensor outputs and performs the initial and continuous algorithms to produce an attitude solution to be used for display in the aircraft or for a guidance and/or control application for the aircraft.

The attitude determining device 20 may be of a strap down system which is mechanically mounted to the case of the device or a gimballed instrument having elements which are free to rotate in inertial space independent of the case of the unit.

In either case, in locating the attitude determining device 20 on board a moving craft, like an aircraft, for example, it may be installed at an unknown orientation with respect to the reference coordinate system of the craft which in the present embodiment are the three orthogonal axes X, Y and Z. It is desired that the device be mounted level with the lateral and longitudinal axes of the craft and aligned with the longitudinal X axis such as shown in Fig. 2, but this may not always be possible due to errors in mechanical leveling or adjusting of the orientation and due to errors in manufacturing tolerances of the device and the aircraft structure where the device is being mounted. This is especially evident when the attitude determining device 20 is mounted on a panel in the cockpit of the aircraft 10 much as illustrated in the sketch of Fig. 3.

Referring to Fig. 3, when the attitude determining device 20 is installed on an aircraft instrument panel 30, the device may not be aligned with the "waterline" or level line of the aircraft in order to compute accurate attitude information. This is because the panel is often not perpendicular to the waterline and it is not possible in most cases to exactly compensate mechanically for the panel angle offset to the vertical or Z axis. In accordance with the present invention, a method is described below which ensures an accurate calculation of the attitude of a moving craft, like an aircraft, for example, by measuring the installation orientation of the device 20 with respect to the reference coordinate axes of the aircraft and compensating for this orientation mathematically in a processor of the device 20.

In the present embodiment, upon installation of the device 20 on the instrumentation panel 30 of the craft 10, whose reference coordinate axes have been leveled to coincide with earth frame, the installation orientation thereof is automatically measured by the installed device 20 and stored in a non-volatile memory thereof. For example, the pitch, ϕ .

and the roll, ρ_c , are measured using the acceleration sensors of the device 20 and this measurement is exemplified by the illustrations of Figs. 4A and 4B. In Fig. 4A, the panel 30 and mounted device 20 is shown in the plane of the axes Z and Y to describe the measurement of the roll angle ρ_c of the installed device 20. In the plane of the axes Z and Y, the acceleration vectors a_y and a_z are added vectorially to yield the gravity vector g . The installation roll angle ρ_c about the X axis is the angle between the vectors g and a_z and may be determined mathematically in accordance with a trigonometric function of the ratio of a_y to a_z .

Similarly, the perspective of the device 20 installed on the panel 30 in the plane of the axes X and Z is shown in Fig. 4B. Referring to Fig. 4B, in this perspective, the acceleration vectors a_z and a_x add up vectorially to yield the gravity vector g and the pitch angle ϕ_c is the angle between the vectors g and a_z , which is a rotation about the Y axis. The installation pitch angle ϕ_c may be determined mathematically in accordance with a trigonometric function of the ratio of a_x to a_z . In the present embodiment, the trigonometric function used for determining the installed roll and pitch angles for static orientation of the device 20 is the arcsine.

A block diagram schematic representing a suitable embodiment of the attitude determining device is shown in Figure 5. Referring to Figure 5, after the device is installed on the instrument panel of a leveled craft 10, for example, and power is subsequently activated to the device 20, an internal processor 52 of the device 20 samples the outputs of the acceleration sensors depicted in the block 50 in all three axes a_x, a_y, a_z . The static angles of the device 20 with respect to earth frame are determined by the processor 52 from the static acceleration measurements based on the trigonometric function described above. The installation angles ϕ_c and ρ_c are read from non-volatile memory 54 of the device 20 and the attitude of the craft 10 with respect to earth frame is

determined by the processor 52 by subtracting these installation angles ϕ_c and ρ_c from the static angles of the device 20 with respect to earth frame. Thereafter, the pitch and roll attitude angles of the moving craft 10 are computed conventionally by the processor 52 via the rate sensors ω_x , ω_y , ω_z , which are shown at block 56 of the device 20 and received by the processor 52. In a gimballed attitude determining device the angles of the spin axis, measured using synchros or other such devices, with respect to the case are corrected by subtracting the installation angles ϕ_c and ρ_c to yield actual aircraft pitch and roll attitude angles.

In summary, for the case in which the craft is leveled according to the description supplied above prior to sensing the installation orientation of device 20, the processor 52 samples the outputs a_x , a_y , and a_z of the acceleration sensors 50. The static installation angles ϕ_c and ρ_c are determined by the processor 52 from the static acceleration measurements based on the trigonometric function described above and are stored in a non-volatile memory 54 for use in compensating the attitude measurements with respect to earth frame. Power to device 20 may then be removed. Subsequent power application to device 20 would allow a measurement of the attitude of the aircraft, i.e. orientation of the aircraft's reference coordinate axes with respect to earth frame, to be correctly determined by processor 52 using ϕ_c and ρ_c from the memory 54.

In some applications, the attitude determining device 20 may not include acceleration sensors 50 but rather include level sensors for sensing directly the pitch ϕ_{case} and roll ρ_{case} of the installed case with respect to the earth frame. A block diagram schematic suitable for exemplifying an alternate embodiment of the device 20 including level sensors is shown in Fig. 6 with the level sensing depicted at 58. Like reference numerals are given to the other elements of the device 20 to match those described in connection with the embodiment of Fig. 5. In operation, the processor receives the installation

orientation angles ϕ_{case} and ρ_{case} measured by the level sensors at 58 and stores them in the non-volatile memory 54 as ϕ_c and ρ_c to be accessed subsequently in compensating for the attitude angle measurements as described in connection with the embodiment of Fig. 5.

The foregoing method provides for compensating for the installation orientation of the device 20 for a leveled craft. If the craft 10 is not in a level attitude as shown in the exemplified illustration of Fig. 7, the actual unlevel aircraft attitude may be measured i.e. reference coordinate axes of the aircraft with respect to earth frame, allowing the processor 52 to determine the offset angles of pitch and roll, ϕ_o and ρ_o , respectively, from a level attitude. These pitch and roll angle offsets from a level condition of the aircraft may be input either manually or electrically to the processor 52 of the device 20 as shown in Figures 5 and 6. In addition, the static installation angles are measured by device 20 with respect to the unleveled aircraft coordinate axes. In order for the processor 52 of device 20 to calculate the effective static installation pitch and roll angles, ϕ_c and ρ_c , of the case with respect to a level reference coordinate system of the craft 10, it may subtract the measured offset angles from their respective measured installation angles. The effective static orientation measurements of the case with respect to the craft's reference coordinate system may then be stored in the memory 54 as shown in Figures 5 and 6 in order to compensate for the installation orientation of the device in the craft 10 as described supra.

In attitude determining devices in which there is no non-volatile memory, the step of sensing the installation orientation of the device to obtain a static orientation measurement with respect to the reference coordinate system of the craft may be performed each time the power is turned on and the aircraft is in a static condition. The resulting static orientation measurement may be stored in the memory of

10

the device for use in compensating for attitude measurements for the moving craft.

While the invention has been described herein in connection with a preferred embodiment, it should not be so
5 limited, but rather construed in accordance with the breadth and broad scope of the claim set appended hereto.

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We Claim:

1. A method of compensating for installation orientation of an attitude determining device on-board a mobile craft with respect to a reference coordinate system of said craft to obtain attitude information of said craft from said device based on an earth frame coordinate system, said method comprising the steps of:

installing said attitude determining device on-board said mobile craft at an unknown orientation with respect to said reference coordinate system of said craft;

sensing the installation orientation of said attitude determining device with respect to said earth frame coordinate system when said craft is at rest to obtain a static orientation measurement of said device;

measuring an attitude of said mobile craft with said attitude determining device; and

compensating said craft attitude measurement of said device with said static orientation measurement to obtain attitude information of said craft's reference coordinate system with respect to said earth frame coordinate system.

2. The method in accordance with claim 1 wherein the reference coordinate system of said craft includes three orthogonal axes - a vertical or z axis, a longitudinal or x axis and a lateral or y axis.

3. The method in accordance with claim 2 wherein the step of sensing includes:

leveling the craft while at rest such that the z axis is aligned with a gravity vector and no substantial at rest acceleration exists at the x and y axes;

sensing the acceleration at the device for each of said three axes - $a(x)$, $a(y)$ and $a(z)$ while the craft is at rest and leveled; and

determining the static orientation measurement of said device based on a function of said three sensed axis accelerations - $a(x)$, $a(y)$, and $a(z)$.

4. The method in accordance with claim 3 wherein the step of determining includes:

determining a static attitude pitch of the device as a trigonometric function of a ratio of the sensed accelerations $a(x)$ and $a(z)$; and

determining a static attitude roll of the device as a trigonometric function of a ratio of the sensed accelerations $a(y)$ and $a(z)$; and

wherein the static orientation measurement of the device comprises the determined static attitude pitch and static attitude roll.

5. The method in accordance with claim 4 wherein the step of measuring includes measuring an attitude pitch and an attitude roll of the mobile craft with said device; and the step of compensating includes compensating the measured attitude pitch with the static attitude pitch and compensating the measured attitude roll with the static attitude roll.

6. The method in accordance with claim 2 wherein the step of sensing includes:

sensing the acceleration at the device for each of said three axes - $a(x)$, $a(y)$ and $a(z)$ while the craft is at rest and unlevelled;

obtaining a static attitude of the craft while at rest and unlevelled;

determining the static orientation measurement of said device based on said static craft attitude and a function of said three sensed axis accelerations - $a(x)$, $a(y)$ and $a(z)$.

13

7. The method in accordance with claim 6 wherein the step of obtaining includes:

obtaining a static craft pitch and a static craft roll;
and

5 the step of determining includes:

determining a static attitude pitch of the device as a trigonometric function of a ratio of the sensed accelerations $a(x)$ and $a(z)$ and said static craft pitch; and

10 determining a static attitude roll of the device as a trigonometric function of a ratio of the sensed accelerations $a(y)$ and $a(z)$ and said static craft roll; and

wherein the static orientation measurement of the device comprises the determined static attitude pitch and static attitude roll.

15 8. The method in accordance with claim 7 wherein the step of measuring includes measuring an attitude pitch and an attitude roll of the mobile craft with said device; and the step of compensating includes compensating the measured attitude pitch with the static attitude pitch and compensating
20 the measured attitude roll with the static attitude roll.

9. The method in accordance with claim 1 wherein the step of sensing includes:

leveling the craft while at rest;

25 sensing an installation pitch and an installation roll of the device while the craft is at rest and leveled; and

wherein the static orientation measurement of the device comprises the sensed installation pitch and roll of the device.

10. The method in accordance with claim 9 wherein the step of measuring includes measuring an attitude pitch and an attitude roll of the mobile craft with said device; and the step of compensating includes compensating the measured attitude pitch with the sensed installation pitch and compensating the measured attitude roll with the sensed installation roll.

11. The method in accordance with claim 1 wherein the step of sensing includes:

- 10 sensing an installation pitch and an installation roll of the device while the craft is at rest and unlevelled;
obtaining a static attitude pitch and a static attitude roll of the craft while at rest and unlevelled;
determining a static attitude pitch of said device based
15 on a combination of said static craft attitude pitch and said installation pitch and a static attitude roll of the device based on a combination of said static craft attitude roll and said installation roll.

wherein the static orientation measurement of the device
20 comprises the determined static device attitude pitch and static device attitude roll.

12. The method in accordance with claim 11 wherein the step of measuring includes measuring an attitude pitch and an attitude roll of the mobile craft with said device; and the
25 step of compensating includes compensating the measured attitude pitch with the static device attitude pitch and compensating the measured attitude roll with the static device attitude roll.

13. The method in accordance with claim 1 wherein the
30 mobile craft is an aircraft, and the attitude device is installed on an instrumentation panel of said aircraft.

15

14. The method in accordance with claim 1 wherein the attitude determining device comprises a strapdown attitude instrument.

15. The method in accordance with claim 1 wherein the
5 attitude determining device comprises a gimballed attitude instrument.

16. A method of compensating for installation
orientation of an attitude determining device on-board a
mobile craft with respect to a reference coordinate system of
10 said craft to obtain attitude information of said craft from
said device based on an earth frame coordinate system, said
method comprising the steps of:

installing said attitude determining device on-board said
mobile craft at an unknown orientation with respect to said
15 reference coordinate system of said craft;

sensing the installation orientation of said attitude
determining device with respect to said earth frame coordinate
system when said craft is at rest to obtain a static
orientation measurement of said device;

20 storing said static orientation measurement in a memory;
measuring an attitude of said mobile craft with said
attitude determining device;

retrieving said static orientation measurement from said
memory to a processor of said device; and

25 compensating said craft attitude measurement with said
retrieved static orientation measurement in said processor to
obtain attitude information of said craft's reference
coordinate system with respect to said earth frame coordinate
system.

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17. The method in accordance with claim 16 wherein the step of sensing includes:

sensing the installation orientation of the device with sensors disposed at the device;

5 receiving in the processor sensed orientation data of said sensors; and

processing the received data in the processor to obtain the static orientation measurement of the device.

18. The method in accordance with claim 17 wherein the
10 step of sensing includes sensing the installation orientation of the device with acceleration sensors.

19. The method in accordance with claim 17 wherein the step of sensing includes sensing the installation orientation of the device with level sensors.

15 20. The method in accordance with claim 16 wherein the step of compensating includes:

obtaining a static attitude of the craft while at rest and unlevelled;

providing said static craft attitude to the processor of
20 said device; and

compensating said craft attitude measurement with said retrieved static orientation measurement and static craft attitude in said processor to obtain attitude information of the craft's reference coordinate system with respect to the
25 earth frame coordinate system.

08/785,553

17

Abstract

In accordance with the disclosed method, an attitude determining device which is installed onboard a mobile craft, like an aircraft, for example, at an unknown orientation with respect to the reference coordinate system of the craft senses its installation orientation with respect to an earth frame coordinate system when the craft is at rest to obtain a static orientation measurement thereof. Thereafter, an attitude of the mobile craft with respect to the earth frame is measured with the attitude determining device and such measurement is compensated with the static orientation measurement to obtain attitude information of the craft's reference coordinate system with respect to the earth frame coordinate system. The installation orientation of the attitude determining device may be sensed while the craft is at rest in either a leveled or unleveled condition.

IR960014

Docket No: 1960053

DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that my residence, post office address and citizenship are as stated below next to my name, and I verily believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed for which a patent is sought on the invention entitled:

**A METHOD OF COMPENSATING FOR INSTALLATION ORIENTATION
OF AN ATTITUDE DETERMINING DEVICE ONBOARD A CRAFT**

the application of which

☒ is attached hereto.
☐ was filed on _____ as Application Serial No. _____.

I hereby state that I have reviewed and understand the contents of the attached or the above-identified application including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, Section 1.56(a).

I hereby claim the benefit under Title 35, United States Code, Sections 365, 120 and/or 119 of all United States, PCT international and/or foreign application(s) listed below and insofar as the subject matter of each of the claims of this application is not disclosed in such prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, Section 1.56(a), which occurred between the filing date of the prior application and the national or PCT international filing date of this application and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Application Serial No.	Filing Date	Country	Status

I hereby appoint as my attorneys and/or agent(s) Mary Ann Tucker, Reg. No. 27,081; Nestor W. Shust, Reg. No. 23,034; David M. Ronyak, Reg. No. 29,106; Richard A. Romanchik, Reg. No. 33,766; William E. Zitelli, Reg. No. 28,551; Kevin L. Leffel, Reg. No. 37,379; James M. Rashid, Reg. No. 31,290, with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith. Address all telephone calls to William E. Zitelli at telephone number 216/447-5921. Please mail all correspondence to The B.F. Goodrich Company, Patent Law Department, 9921 Brecksville Road, Brecksville, Ohio 44141-3289.

I declare further that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Inventor's Signature ¹⁰⁰ Gary Stewart Watson Date 12/11/96
 Inventor's Typed Name: Gary Stewart Watson Citizenship: USA
 Residence (City): Ada State/Foreign Country: Michigan
 Post Office Address: 6475 Redington Drive, S.E., Ada, Michigan 49301-9020 MI

²⁰⁰
 Inventor's Signature Krishna Devarasetty Date 12/11/96
 Inventor's Typed Name: Krishna Devarasetty Citizenship: USA
 Residence (City): Kentwood State/Foreign Country: Michigan
 Post Office Address: P.O. Box 88151, Kentwood, Michigan 49548 MI

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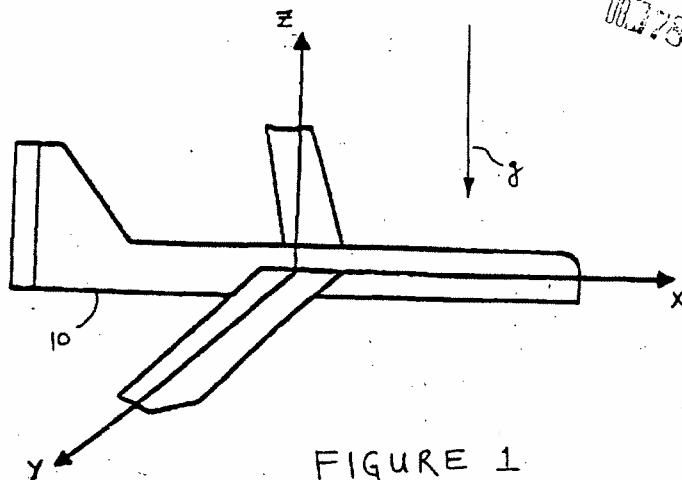


FIGURE 1

level
cond. $a_z = g$
 $a_y = a_x = 0$

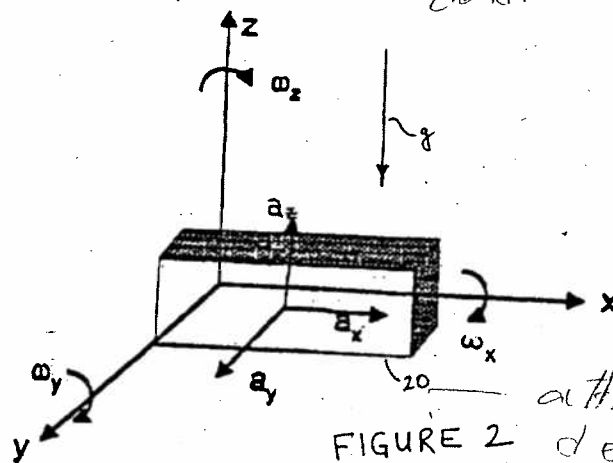


FIGURE 2 attitude
determination
device

acceleration

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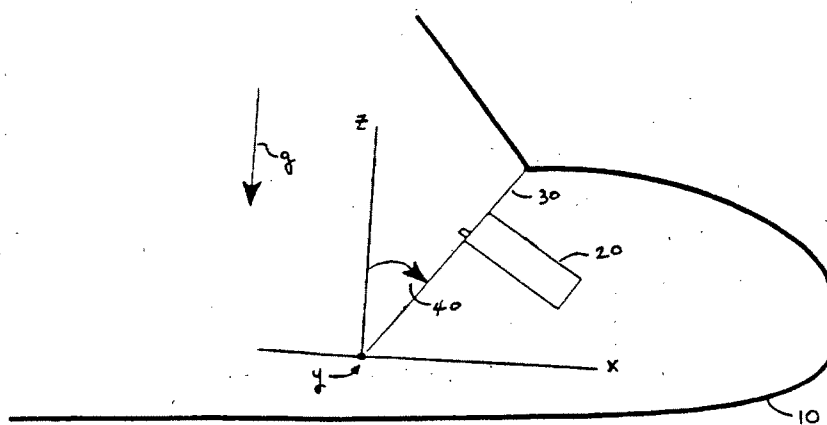


FIGURE 3

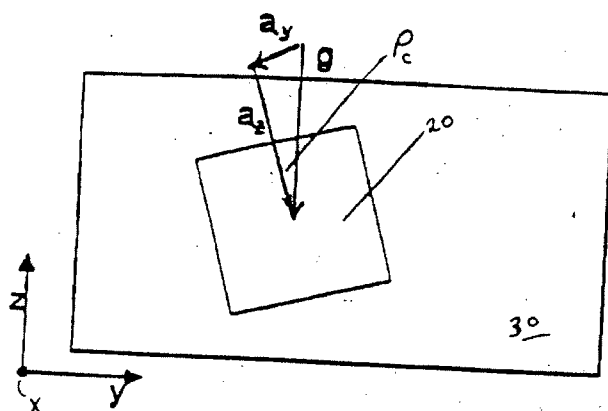


FIGURE 4A

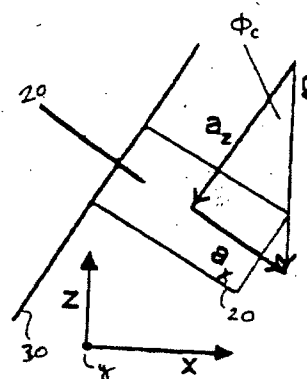


FIGURE 4B

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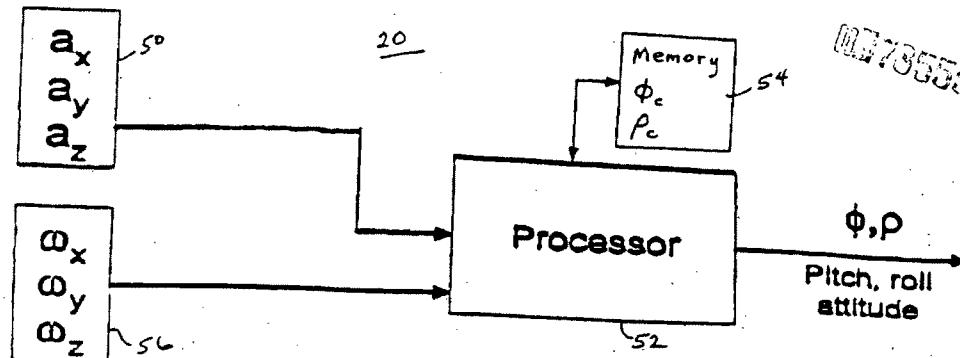


FIGURE 5

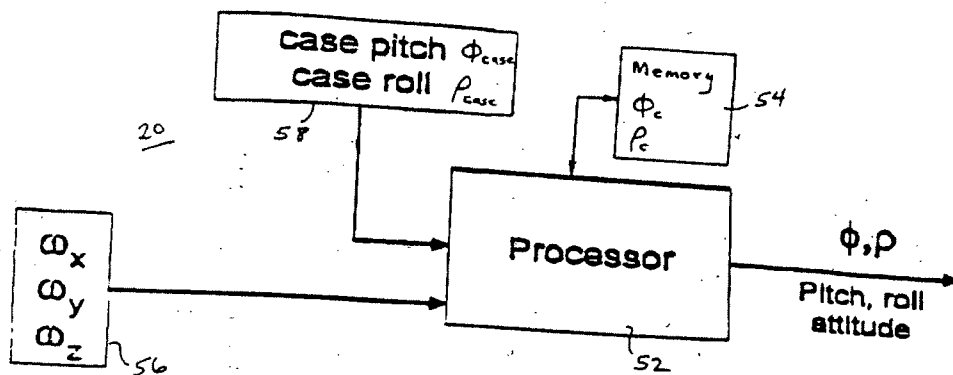
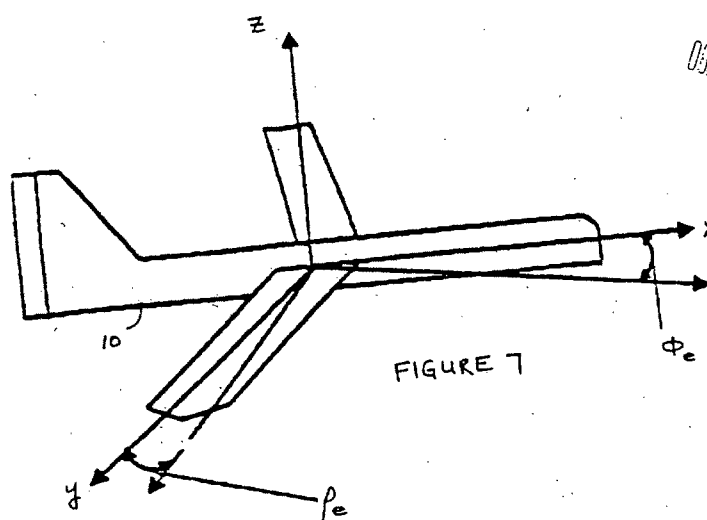


FIGURE 6

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**UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office**

 Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

SERIAL NUMBER	FILING DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO.
08/785,553	1/13/97	GARY STEWART WATSON ET AL	1960053

 WILLIAM E. ZITELLI
THE B.F. GOODRICH COMPANY
PATENT LAW DEPARTMENT
9921 BRECKSVILLE ROAD
BRECKSVILLE, OH 44141

EXAMINER	
ART UNIT	PAPER NUMBER
	2

DATE MAILED:

MAR 12 1997

**IF NO RESPONSE TO THIS NOTICE IS RECEIVED WITHIN FORTY-FIVE DAYS, A
FORMAL REQUIREMENT WILL BE ISSUED**

The subject matter of this application appears to:

- ☐ be "useful in the production or utilization of special nuclear material or atomic energy" as recited in 42 U.S.C. 2182 (Department of Energy (DOE)).
- ☒ "have significant utility in the conduct of aeronautical and space activities" as recited in 42 U.S.C. 2457 (National Aeronautics and Space Administration (NASA)).

Accordingly, no patent can issue on this application unless applicant(s) file a statement (under oath or in the form of a declaration as provided by 37 CFR 1.68) setting forth (1) the full facts concerning the circumstances under which the invention was made and conceived and (2) the relationship (if any) of the invention to the performance of any work under any contract or other arrangement with the Agency(ies) noted above. On the reverse side of this form is an example of an acceptable format for this statement. The language appearing in paragraphs III and/or IV of the example *must* appear if applicant is attempting to establish that no relationship (under item 2 above) exists.

If the invention disclosed in this application was developed under a contract, grant or cooperative agreement between the Agency indicated above and a person, small business or non-profit organization and rights to the invention have been determined by specific reference to 35 U.S.C. 202 in the contract, grant or cooperative agreement, then applicant need not submit the statement described above. Instead, applicant may file a verified statement (under oath or in the form of a declaration, 37 CFR 1.68) setting forth the information required by 35 U.S.C. 202(c)(6).

IF NO STATEMENT HAS BEEN RECEIVED WITHIN FORTY-FIVE DAYS OF THE MAIL DATE INDICATED ABOVE, a formal requirement for statement will then be issued. No provision is made for extension of the statutory thirty-day period for response to the formal requirement and the penalty for failure to file an acceptable and timely statement is abandonment of the application. Therefore, applicants are strongly encouraged to submit a statement at this time in order to avoid the issuance of a formal requirement.

IT IS IMPORTANT TO NOTE that the statement must accurately represent the property rights situation of the claimed invention if and when the application is found allowable. Thus, if during prosecution before the examiner, the claimed invention is so altered or the property rights situation so changed as to impact the accuracy of a statement submitted earlier, a supplemental statement must be filed. Failure to submit such additional information where appropriate may be considered a false representation of material facts and render the patent owner vulnerable to loss of patent rights and other sanctions as set forth in the statutes. The PTO will not review allowed applications for this possibility. The responsibility for complying with the statutes rests with the applicants.

Any questions regarding this requirement should be directed to Licensing and Review at (703) 308-3312.

**PLEASE DIRECT ALL COMMUNICATIONS RELATING TO THIS MATTER TO THE
ATTENTION OF LICENSING AND REVIEW**

APR 04 1997

#3
PATENT
Docket No.: 1960053
4/24/97

Application of: Gary Stewart Watson, et al

ATTN: LICENSING & REVIEW

Serial No.: 08/785,553

Filed: 12/13/96

For: **A METHOD OF COMPENSATING FOR INSTALLATION ORIENTATION
OF AN ATTITUDE DETERMINING DEVICE ONBOARD A CRAFT**

The Commissioner of Patents and Trademarks
Washington, D.C. 20231

RECEIVED

APR 9 1997

Sir:

TRANSMITTAL LETTER LICENSING & REVIEW

Responsive to the informal Notice dated 03/12/97 that the subject matter of the captioned application appears to "have significant utility in the conduct of aeronautical and space activities" as recited in 42 U.S.C. 2457 (NASA) applicants submit the enclosed statement.

No additional fee is required.

Please charge my Deposit Account No. 07-1625 in the amount of \$0. The Commissioner is hereby authorized to charge payment of any additional filing fees required under 37 CFR 1.16 associated with this communication or credit any overpayment to Deposit Account No. 07-1625. A duplicate copy of this sheet is enclosed.

Respectfully submitted,

The B.F. Goodrich Company
9921 Brecksville Road
Brecksville, Ohio 44141-3289
Telephone: (216) 447-5931

William E. Zitelli
William E. Zitelli
Attorney for Applicants
Reg. No. 28,551

CERTIFICATE OF MAILING UNDER 37 CFR § 1.8(a)

I hereby certify that this correspondence (along with any paper referred to as being attached or enclosed) is being deposited with the United States Postal Service on the date shown below as first class mail in an envelope addressed to: COMMISSIONER OF PATENTS AND TRADEMARKS, WASHINGTON, D.C. 20231, on the date below:

Date of Deposit: April 1, 1997

Depositor: Cynthia L. Kemery
Cynthia L. Kemery

Docket No. 1960053

PROPERTY RIGHTS DECLARATION

I/we (names are listed below),

Inventor: Gary Stewart Watson
Citizenship: United States
Residence: 6475 Redington Drive, S.E., Ada, MI 49301-9020

Inventor: Krishna Devarasetty
Citizenship: United States
Residence: P.O. Box 88151, Kentwood, MI 49548

hereby declare:

That I/We made and conceived the invention described and
claimed in patent application:

Serial Number: 08/785,553

Filing Date: 12/13/96

OK
Titled: **A METHOD OF COMPENSATING FOR INSTALLATION
ORIENTATION OF AN ATTITUDE DETERMINING DEVICE
ONBOARD A CRAFT**

[X] That I, (we) made and conceived this invention while
employed by BFGoodrich Avionics Systems, Inc.. That the
invention is related to the work I am (we are) employed
to perform and was made within the scope of my (our)
employment duties; That the invention was made during
working hours and with the use of facilities, equipment,
materials, funds, information and services of BFGoodrich
Avionics Systems, Inc..

That to the best of my (our) knowledge and belief:

[] The invention was not made or conceived in the course of,
or in connection with, or under the terms of any
contract, subcontract or arrangement entered into with or
for the benefit of the United States Atomic Energy
Commission or its successors; Energy Research and
Development Administration or the Department of Energy.

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LICENSING & REVIEW

Property Rights Declaration
Docket No. 1960053
Page 2

-AND OR-

- [X] The invention was not made (conceived or first actually reduced to practice) under nor is there any relationship of the invention to the performance of any work under any contract of the National Aeronautics and Space Administration.

The undersigned inventor(s) declare further that all statements made herein of his or her (their) own knowledge are true and that all statements made on information and belief are believed to be true and further that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Inventor's Signature Gary Stewart Watson Date: 3/28/97
Gary Stewart Watson

Post Office Address: 6475 Redington Dr., S.E.
Ada, Michigan 49301-9020

Inventor's Signature D. Krishna Devarasetty Date: 3/28/97
Krishna Devarasetty

Post Office Address: P.O. Box 88151
Kentwood, Michigan 49548

(EXHIBIT 2)

PTO-103X
(Rev. 8-95)

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APPLICATION NUMBER	FILING DATE	GRP ART UNIT	FIL FEE REC'D	ATTORNEY DOCKET NO.	DRWGS	TOT CL	IND CL
08/785,553	01/13/97	3107	\$770.00	1960053	4	20	2

 THE B F GOODRICH COMPANY
 PATENT LAW DEPARTMENT
 9921 BRECKSVILLE ROAD
 BRECKSVILLE OH 44141-3289

ENTD MAR 31 1997

Receipt is acknowledged of this nonprovisional Patent Application. It will be considered in its order and you will be notified as to the results of the examination. Be sure to provide the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION when inquiring about this application. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please write to the Application Processing Division's Customer Correction Branch within 10 days of receipt. Please provide a copy of the Filing Receipt with the changes noted thereon.

Applicant(s)

 GARY S. WATSON, ADA, MI; KRISHNA DEVARASETTY, KENTWOOD,
 MI.

TITLE

 METHOD OF COMPENSATING FOR INSTALLATION ORIENTATION OF AN ATTITUDE
 DETERMINING DEVICE ONBOARD A CRAFT

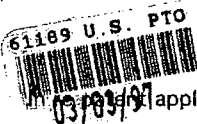
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Patent Law Department



UNITED STATES PATENT AND TRADEMARK OFFICE

 PATENT
 Docket No. 1960053

Application of

 Applicant: Watson, Gary S., et al
 Serial No: 08/785,553
 Filed: 12/13/96

 For: A METHOD OF COMPENSATING FOR INSTALLATION ORIENTATION
 OF AN ATTITUDE DETERMINING DEVICE ONBOARD A CRAFT

 Assistant Commissioner of Patents
 Washington, D.C. 20231

 RECEIVED
 MAY 15 1997
 GROUP 2200
INFORMATION DISCLOSURE STATEMENT

Sir:

1. Pursuant to 37 C.F.R. 1.97 and 1.98, and in compliance with 37 C.F.R. 1.56, the Office's attention is directed to the patents, publications and other information listed on the attached PTO-1449. A copy of each listed document is enclosed except for: (a) pending applications or (b) those previously cited or submitted to the Office in the following application(s) upon which this application relies for an earlier filing date under 35 U.S.C. 120:

 Serial No.: _____
 Filing Date: _____

Regarding any document, publication or other information for which a date is not given on the attached PTO-1449, Applicant(s) believe(s) the same may qualify as "prior" art to this application and should be treated accordingly, although Applicant(s) reserve(s) the right to contest the prior art status of any document, publication or information, should issue arise.

2. Regarding each listed document that is not in the English language, an English-language translation accompanies this Statement as indicated on the attached PTO-1449 or a concise explanation of the relevance of the document is set forth in the following document(s):

- ☐ (a) Copy of English language version of a search report indicating the degree of relevance found by the foreign office of each document being submitted from the search report.
- ☐ (b) Attachment entitled "Concise Explanation of Relevance of Non-English Language Documents".

3. Pursuant to 37 C.F.R. 1.97(b) this Statement is being filed:

- ☒ (a) Within 3 months of the filing date or date of entry into the National Stage.
- ☐ (b) Before the mailing date of a first Office Action on the merits. If this Statement is not filed before the mailing date of a first Office Action on the merits, the required certification is given below or, in the absence thereof, the Office is authorized to

charge the required fee set forth in 37 C.F.R. 1.17(p) to Deposit Account No. 07-1625 for consideration of this Statement.

☐ (c) After the period set forth in 37 C.F.R. 1.97(b) but before the mailing date of either a final action or a notice of allowance.

☐ (1) The required certification is given below, or

☐ (2) Charge the fee set forth in 37 C.F.R. 1.17(p) to Deposit Account No. 07-1625.

☐ (d) After the mailing date of either a final action or a notice of allowance, but before payment of the issue fee. Petition hereby is made for consideration of this Statement and the required certification is indicated below.

☐ (1) Charge the fee set forth in 37 C.F.R. 1.17(i)(1) to Deposit Account No. 07-1625.

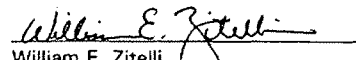
4. Certification (if applicable)

☐ (a) The undersigned hereby certifies that each item of information contained in this Statement was cited in a communication from a foreign patent office in a counterpart foreign application not more than 3 months prior to the filing of this Statement.

☐ (b) The undersigned hereby certifies that no item of information contained in this Statement was cited in a communication from a foreign patent office in a counterpart foreign application or, to the undersigned's knowledge after making reasonable inquiry, was known to any individual designated in 37 C.F.R. 1.56(c) more than 3 months prior to the filing of this Statement.

5. The Commissioner is hereby authorized to charge any additional fees or credit any overpayment to Deposit Account No. 07-1625.

Respectfully submitted,

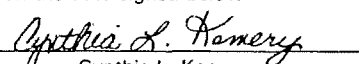

William E. Zitelli
Attorney for Applicants
Reg. No. 28,551

The B.F. Goodrich Company
9921 Brecksville Road
Brecksville, Ohio 44141-3289
Telephone: (216) 447-5921

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service on the date shown below as first class mail in an envelope addressed to: COMMISSIONER OF PATENTS AND TRADEMARKS, WASHINGTON, D.C. 20231, on the date signed below

February 27, 1997
Date: February 27, 1997


By: Cynthia L. Kemery



2002

#6

Docket No. 960053

UNITED STATES PATENT AND TRADEMARK OFFICE

Application of: Gary S. Watson and Krishna Devarasetty

Serial No.: 08/785,553
Filed: 12/13/96

Art Unit: 3107
Examiner: Unknown

For: A METHOD OF COMPENSATING FOR INSTALLATION ORIENTATION
OF AN ATTITUDE DETERMINING DEVICE ONBOARD A CRAFT

Assistant Commissioner of Patents
Washington, D.C. 20231

RECEIVED

APR 23 1997

GROUP 2200

PETITION TO THE COMMISSIONER PURSUANT TO 37 CFR § 1.10(C)

Dear Sir:

On December 13, 1996, my Secretary, Cynthia Kemery, deposited a copy of the above-identified application along with its transmittal sheet (see attached Exhibit 1) with the United States Postal Service's "Express Mail Post Office to Addressee" under 37 CFR § 1.10 for obtaining a filing date under 37 CFR § 1.10(a) therefor.

On March 26, 1997, Applicants received the filing receipt of the above-identified application (see attached Exhibit 2) and recognized that there was a discrepancy between the filing date accorded by the Patent Office, January 13, 1997, and the date of deposit as shown by the "date in" on the "Express Mail" mailing label, December 13, 1996. A true copy of the "Express Mail" mailing label showing the "date in" is attached as Exhibit 3.


The number EM286807830US of the "Express Mail" mailing label (see Exhibit 3) was placed on the transmittal sheet (see Exhibit 2) of the above-identified application prior to the original mailing by "Express Mail" by my Secretary, Cynthia Kemery, as evidenced by the Express Mail Certification statement thereon.

A copy of a letter from the United States Postal Service (USPS) addressed to one of our Paralegals, Judy Beasley, is attached as Exhibit 4 to explain the time period between deposit in the USPS and delivery to the USPTO of the above-identified patent application. I can not explain the USPS's claim of delivery on January 21, 1997 in the letter of Exhibit 4 and the USPTO's accorded filing date of January 13, 1997.

In view of the foregoing facts, Applicants hereby petition the Commissioner under 37 CFR § 1.10(c) to accord the above-identified application the filing date as of the "date in" or the "Express Mail" mailing label of Exhibit 3. In addition, Applicants further petition that the filing receipt be corrected to reflect the December 13, 1996 filing date, and that a corrected copy of the filing receipt reflecting the December 13, 1996 filing date be sent to Applicants, and that all further USPTO correspondence related to the above-identified application bear the filing date of December 13, 1996, where applicable.

The Commissioner is hereby authorized to charge payment of any fees associated with the filing of this petition or additional fees required under 37 CFR 1.16 associated with this communication or credit any overpayment to Deposit Account No. 07-1625.

Respectfully submitted,

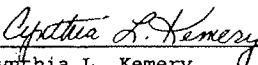

William E. Zitenli
Attorney for Applicant(s)
Registration No. 28,551

The B.F. Goodrich Company
9921 Brecksville Road
Brecksville, OH 44141-3289
Telephone: (216) 447-5921

CERTIFICATE OF MAILING

I hereby certify that this correspondence (along with any referred to as being attached or enclosed) is being deposited with the United States Postal Service on the date shown below with sufficient postage as first class mail in an envelope addressed to: COMMISSIONER OF PATENTS AND TRADEMARKS, WASHINGTON, D.C. 20231.

Date of Deposit: April 1, 1997


Cynthia L. Kemery

(EXHIBIT 1)

PATENT
Docket No. 1960053Assistant Commissioner of Patents
Washington, D.C. 20231

Sir:

TRANSMITTED HERewith FOR FILING IS THE PATENT APPLICATION OF

INVENTOR(S): Gary Stewart Watson and Krishna Devarsaetty

FOR: A METHOD OF COMPENSATING FOR INSTALLATION ORIENTATION
OF AN ATTITUDE DETERMINING DEVICE ONBOARD A CRAFT

ENCLOSED ARE:

- [X] Specification and Claims
- [X] 4 Sheets of Informal Drawings
- [X] Combined Declaration and Power of Attorney
- [X] Postpaid Return Addressed Receipt Card

The filing fee has been calculated as shown below:


FOR:	NO. FILED	NO. EXTRA	RATE	FEE
			BASIC FEE	\$770
TOTAL CLAIMS	20 [- 20] =	0	x \$22 =	\$0
INDEP CLAIMS	2 [- 3] =	0	x \$80 =	\$0
[] MULTIPLE DEPENDENT CLAIM PRESENTED			x \$260 =	\$0

TOTAL: \$770.

Please charge Deposit Account No. 07-1625 in the amount of \$770.00.

The Commissioner is hereby authorized to charge payment of the following fees during the pendency of this application or credit any overpayment to Deposit Account No. 07-1625.
Any filing fees under 37 CFR 1.16 for presentation of extra claims.
Any patent application processing fees (except Issue Fee) under 37 CFR 1.17.
A DUPLICATE COPY OF THIS SHEET IS ENCLOSED.

The B.F. Goodrich Company
9921 Brecksville Road
Brecksville, Ohio 44141-3289
Telephone: (216) 447-5921


William E. Zitelli
Attorney of Record
Reg. No. 28,551

EXPRESS MAIL CERTIFICATE

"EXPRESS MAIL" MAILING LABEL NUMBER: EM286807830US

Date of Deposit: December 13, 1996

I hereby certify that this correspondence (including any paper or fee referred to herein) is being deposited with the United States Postal Service's "Express Mail Post Office to Addressee" Service under 37 C.F.R. 51.10 on the date indicated above in an envelope addressed to:
COMMISSIONER OF PATENTS AND TRADEMARKS, WASHINGTON, D.C. 20231.

Printed Name of Person Mailing Correspondence: Cynthia L. Kemery

Signature of Person Mailing Correspondence: 

(EXHIBIT 4)

EXPEDITED SERVICE OFFICE
U S POSTAL SERVICE

RECEIVED

JAN 23 1997

Patent Law Department



January 21, 1997

Judy G. Beasley
B F Goodrich Co.
9921 Brecksville Rd
Cleveland Oh 44141-3201

Dear Ms. Beasley:

Two Express Mail letters sent by B F Goodrich Company on December 13, 1996 were recently found on January 16, 1997 in what was thought to be empty equipment. The mail was found at our Processing & Distribution Center in downtown Cleveland. The tracking numbers of the two Expresses are TB737168377US and EM286807830US. As per your telephoned instructions on January 17, 1997, both Expresses were sent on to their destinations for delivery. Both pieces were delivery attempted on Saturday, January 18, 1997 and then delivered on January 21, 1997. The Patent and Trademark Offices were closed on January 18 to January 20.

On rare occasions, mail may remain undetected for a period of time before it is found, as was the case of these Expresses. The Postal Service, both Nationally and in the Cleveland District, has just experienced the best delivery service rating quarter in our history. We are aware that unfortunate incidents like this are detrimental to our service.

Please accept my sincere apologies for any inconvenience this matter may have caused and be assured that the Postal Service is working hard to eliminate such mishaps. Your Express Mail Corporate Account has been credited for a refund for the total postage of the two mailings.

If I can be of any more assistance to you in regarding these mailings, please contact me.

Yours in Service,

A handwritten signature in cursive script that reads "Lenny Toth".

Lenny Toth
Expedited Services Specialist

Enclosure



UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
ASSISTANT SECRETARY AND COMMISSIONER OF
PATENTS AND TRADEMARKS
Washington, D.C. 20231

Handwritten initials

The B.F. Goodrich Company
Patent Law Department
9921 Brecksville Road
Brecksville, OH 44141-3289

COPY MAILED

JUN 23 1997

**OFFICE OF PETITIONS
AND PATENTS**

In re Application of	:
Gary S. Watson et al.	:
Application No. 08/785,553	: DECISION GRANTING
Filed: December 13, 1996	: PETITION
Attorney Docket No. 1960053	:

This is a decision on the petition filed April 4, 1997, requesting that the above-identified application be accorded a filing date of December 13, 1996, rather than the presently accorded filing date of January 13, 1997.

The application was received in the Patent and Trademark Office (Office) with the Express Mail label number identified thereon as EM286807830US. However, for some reason, the application was accorded a filing date of January 13, 1997.

The present petition is accompanied by a copy of petitioners' Express Mail receipt showing a date of receipt in Express Mail service of December 13, 1996.

In view of the above, the application is entitled to a filing date of December 13, 1996. The petition is granted.

No petition fee is required and none has been charged.

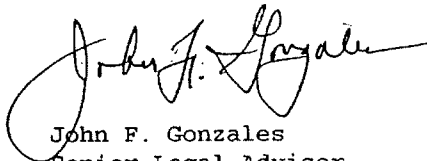
The application is being returned to Initial Patent Examination

Application No. 08/785,553

Page 2

Division for correction of the filing date to December 13, 1996.

Thereafter, the application will be returned to Examining Group
2200 for examination in due course.

A handwritten signature in black ink, appearing to read "John F. Gonzales", is written over the typed name.

John F. Gonzales
Senior Legal Advisor
Special Program Law Office
Office of the Deputy Assistant Commissioner
for Patent Policy and Projects
(703)305-9282

JFG


UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office

 Address: COMMISSIONER OF PATENTS AND TRADEMARKS
 Washington, D.C. 20231

SERIAL NUMBER	FILING DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NO.
08/785,333	12/13/96	WATSON	1960053

THE B F GOODRICH COMPANY
 PATENT LAW DEPARTMENT
 9921 BRECKSVILLE ROAD
 BRECKSVILLE OH 44141-3289

B2M1/1009

EXAMINER	
NGORI, M	
ART UNIT	PAPER NUMBER
2214	8

DATE MAILED: 10/09/97

Please find below a communication from the EXAMINER in charge of this application.

Commissioner of Patents

Office Action Summary	Application No. 08/785,553	Applicant(s) Watson
	Examiner Max H. Noori	Group Art Unit 2214

☐ Responsive to communication(s) filed on _____

☐ This action is **FINAL**.

☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

A shortened statutory period for response to this action is set to expire 3 month(s), or thirty days, whichever is longer, from the mailing date of this communication. Failure to respond within the period for response will cause the application to become abandoned. (35 U.S.C. § 133). Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

Disposition of Claims

☒ Claim(s) 1-20 is/are pending in the application.

Of the above, claim(s) _____ is/are withdrawn from consideration.

☐ Claim(s) _____ is/are allowed.

☒ Claim(s) 1-3, 6, and 9-20 is/are rejected.

☒ Claim(s) 4, 5, 7, and 8 is/are objected to.

☐ Claims _____ are subject to restriction or election requirement.

Application Papers

☒ See the attached Notice of Draftsperson's Patent Drawing Review, PTO-948.

☐ The drawing(s) filed on _____ is/are objected to by the Examiner.

☐ The proposed drawing correction, filed on _____ is ☐ approved ☐ disapproved.

☐ The specification is objected to by the Examiner.

☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

☐ All ☐ Some* ☐ None of the CERTIFIED copies of the priority documents have been

☐ received.

☐ received in Application No. (Series Code/Serial Number) _____

☐ received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

*Certified copies not received: _____

☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

☒ Notice of References Cited, PTO-892

☒ Information Disclosure Statement(s), PTO-1449, Paper No(s). 5

☐ Interview Summary, PTO-413

☒ Notice of Draftsperson's Patent Drawing Review, PTO-948

☐ Notice of Informal Patent Application, PTO-152

--- SEE OFFICE ACTION ON THE FOLLOWING PAGES ---

Serial Number: 08/785,553

Page 2

Art Unit: 2214

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1-2, 9-12 16-17 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Achkar et al., in view of McMurtry.

Regarding claims 1, 9-12, Achkar et al., disclose a rate gyro calibration method and apparatus for three axis stabilized satellite with features of the claimed invention including: installing an attitude determining device on board of said satellite, measuring an attitude of the said satellite, compensating the attitude measurement error (col. 3, line 23). Although, Achkar et al., provide for a rather accurate estimate of the attitude, they do not explicitly recite the utilization of a sensing the installation orientation. Utilization of compensation for installation orientation arrangement on board of mobile craft with respect to a predetermined coordinate system is well known in the art. McMurtry is presented to show such assertion. McMurtry discloses a device for checking the accuracy of coordinate positioning apparatus with components for measuring the coordinate positions. Since Achkar et al., and McMurtry's systems are from the same field of endeavor, the purpose or advantage of McMurtry would have been recognized

Serial Number: 08/785,553

Page 3

Art Unit: 2214

as being pertinent in Achkar et al's device. Therefore, it would have been obvious to an artisan or ordinary skill at the time of invention to incorporate a coordinate or orientation positioning apparatus to Achkar et al's device because McMurtry makes it known that utilization of such device for accurate orientation or positioning is notoriously known in the art and is a necessary device for performing an accurate measurement of attitude and other various related parameters (see McMurtry col. 1).

Regarding claim 2, Achkar et al., show the use of three orthogonal axes.

Regarding claims 16-17, and 20, Achkar et al., show the use of various control, processing and logic means, therefore a computer means with its inherent memory and storing capabilities (col 7. lines 22-27).

3. Claims 3, 6, 13-15, 18-19, are rejected under 35 U.S.C. 103(a) as being unpatentable over Achkar et al., in view of McMurtry and further in view of Duncan et al.

Achkar et al., disclose a rate gyro calibration method and apparatus for three axis stabilized satellite; teaching or suggesting features of the claimed invention. Although they show provision for detecting the speed rate in various axes, and as a result acceleration, they do not specifically or directly recite mean for acceleration measurements. Duncan et al., disclose an aircraft gyro system with means to sense acceleration in three axes. It would have been obvious to one of ordinary skill in the art to modify the combination of Achkar/McMurtry with teachings of Duncan et al., to provide for acceleration sensors because Duncan et al., make it clear that

Serial Number: 08/785,553

Page 4

Art Unit: 2214

utilization of acceleration sensors are well known in the art and have been extensively described and discussed in the literature (col. 1, lines 36-44)

Regarding claim 13, Duncan et al., show an air craft and all the devices can be installed on an instrument panel.

Regarding claims 14 -15, although Achkar/McMurtry do not specifically mention the type of the attitude determination device, it would have been obvious to one of ordinary skill in the art to modify their device to use either strapdown or gimbal attitude instrument because Duncan et al., also shows that these are well known arrangements in the art (see col. 1, line 46-51).

4. Claims 4-5, 7-8 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

10. The subject matters of claims 4-5 and 7-8 are deemed to be patentable because the prior art fail to disclose and/or make obvious the claimed particular compensation method. Major emphasis is being placed upon the provision of "Determination of static attitude pitch" as a "trigonometric function of a ratio" of acceleration components wherein the "orientation measurement" comprises the "static attitude pitch" and "static attitude roll" in combination with remaining limitations of these claims and their dependent ones.

Serial Number: 08/785,553

Page 5

Art Unit: 2214

5. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

The following art are all cited for their notable structure and construction in the related art.

Iddings discloses an all attitude compass.

Watts discloses an aircraft and method for verifying accuracy of positioning apparatus.


Büchler et al., disclose a navigation apparatus with improved attitude determination.

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Max H. Noori whose telephone number is (703) 308-5248. The examiner can normally be reached on Monday-Friday from 8:00 AM to 5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Rich Chilcot, can be reached on (703) 305-4716. The fax number for this group is (703) 308-7382.

Any inquiry of a general nature or relating to the status of this application should be directed to the Group receptionist whose telephone number is (703) 305-4900.

MHN
October 7, 1997


MAX H. NOORI
PATENT EXAMINER
GROUP 220

Notice of References Cited				Application No. 08/785,553		Applicant(s) Watson	
				Examiner Max H. Noori		Group Art Unit 2214	

U.S. PATENT DOCUMENTS						
	DOCUMENT NO.	DATE	NAME	CLASS	SUBCLASS	
A	3,881,258	5/6/75	Iddings	324	247	
B	4,212,443	7/15/80	Duncan et al.	244	177	
C	4,777,818	10/18/88	McMurtry	73	1.79	
D	5,313,410	5/17/94	Watts	73	1.79	
E	5,543,804	8/6/96	Buchler et al.	342	357	
F	5,562,266	10/8/96	Achkar et al.	73	1.79	
G	<i>4982,504</i>	<i>1,8,91</i>	<i>Söderberg et al.</i>	<i>73</i>	<i>1.79</i>	
H						
I						
J						
K						
L						
M						

FOREIGN PATENT DOCUMENTS						
	DOCUMENT NO.	DATE	COUNTRY	NAME	CLASS	SUBCLASS
N						
O						
P						
Q						
R						
S						
T						

NON-PATENT DOCUMENTS	
	DOCUMENT (including Author, Title, Source, and Pertinent Pages)
U	
V	
W	
X	

FORM PTO-1449 U.S. DEPARTMENT OF COMMERCE

(Rev. 2-32)

PATENT AND TRADEMARK OFFICE PTO

INFORMATION DISCLOSURE

STATEMENT BY APPLICANT

(Use several sheets if necessary)

Sheet 1 of 1

ATTY. DOCKET NO.

1960053

SERIAL NO.

08 / 785,553

APPLICANT

Watson, Gary S., et al

FILING DATE

12/13/96

GROUP

Unknown

2214

U.S. PATENT DOCUMENTS

EXAMINER INITIAL	DOCUMENT NUMBER							DATE	NAME	CLASS	SUB- CLASS	FILING DATE IF APPROPRIATE
FW	4	3	1	8	3	0	0	03/09/82	Maughmer			

FOREIGN PATENT DOCUMENTS

	DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUB- CLASS	TRANSLATION YES NO	

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

EXAMINER

Noori

DATE CONSIDERED

10-6-97

Form PTO 948 (Rev. 10-94)

U.S. DEPARTMENT OF COMMERCE - Patent and Trademark Office

Application No.

785553

NOTICE OF DRAFTSPERSON'S PATENT DRAWING REVIEW

PTO Draftpersons review all originally filed drawings regardless of whether they are designated as formal or informal. Additionally, patent Examiners will review the drawings for compliance with the regulations. Direct telephone inquiries concerning this review to the Drawing Review Branch, 703-305-8404.

The drawings filed (insert date) 1/3/97, are:

- 1 not objected to by the Draftsperson under 37 CFR 1.84 or 1.152.
9 objected to by the Draftsperson under 37 CFR 1.84 or 1.152 as indicated below. The Examiner will require submission of new, corrected drawings when necessary. Corrected drawings must be submitted according to the instructions on the back of this Notice.

1. DRAWINGS. 37 CFR 1.84(a): Acceptable categories of drawings:

Black ink. Color.

- Not black solid lines. Fig(s) _____
 Color drawings are not acceptable until petition is granted. Fig(s) _____

2. PHOTOGRAPHS. 37 CFR 1.84(b)

- Photographs are not acceptable until petition is granted. Fig(s) _____
 Photographs not properly mounted (must use bristol board or photographic double-weight paper). Fig(s) _____
 Poor quality (half-tone). Fig(s) _____

3. GRAPHIC FORMS. 37 CFR 1.84 (d)

- Chemical or mathematical formula not labeled as separate figure. Fig(s) _____
 Group of waveforms not presented as a single figure, using common vertical axis with time extending along horizontal axis. Fig(s) _____
 Individuals waveform not identified with a separate letter designation adjacent to the vertical axis. Fig(s) _____

4. TYPE OF PAPER. 37 CFR 1.84(c)

- Paper not flexible, strong, white, smooth, nonshiny, and durable. Sheet(s) _____
 Erasures, alterations, overwritings, interlineations, cracks, creases, and folds copy machine marks not accepted. Fig(s) _____
 Mylar, velum paper is not acceptable (too thin). Fig(s) _____

5. SIZE OF PAPER. 37 CFR 1.84(f): Acceptable sizes:

- 21.6 cm. by 35.6 cm. (8 1/2 by 14 inches)
 21.6 cm. by 33.1 cm. (8 1/2 by 13 inches)
 21.6 cm. by 27.9 cm. (8 1/2 by 11 inches)
 21.0 cm. by 29.7 cm. (DIN size A4)

- All drawing sheets not the same size. Sheet(s) _____
 Drawing sheet not an acceptable size. Sheet(s) _____

6. MARGINS. 37 CFR 1.84(g): Acceptable margins:

Paper size

21.6 cm. X 35.6 cm. (8 1/2 X 14 inches)	21.6 cm. X 33.1 cm. (8 1/2 X 13 inches)	21.6 cm. X 27.9 cm. (8 1/2 X 11 inches)	21.0 cm. X 29.7 cm. (DIN Size A4)
T 5.1 cm. (2")	2.5 cm. (1")	2.5 cm. (1")	2.5 cm.
L .64 cm. (1/4")	.64 cm. (1/4")	.64 cm. (1/4")	2.5 cm.
R .64 cm. (1/4")	.64 cm. (1/4")	.64 cm. (1/4")	1.5 cm.
B .64 cm. (1/4")	.64 cm. (1/4")	.64 cm. (1/4")	1.0 cm.

Margins do not conform to chart above.

Sheet(s) 1-3
 Top (T) _____ Left (L) _____ Right (R) _____ Bottom (B) _____

7. VIEWS. 37 CFR 1.84(h)

REMINDER: Specification may require revision to correspond to drawing changes.

- All views not grouped together. Fig(s) _____
 Views connected by projection lines or lead lines. Fig(s) _____
 Partial views. 37 CFR 1.84(h) 2

View and enlarged view not labeled separately or properly.

- Fig(s) _____
 Sectional views. 37 CFR 1.84 (h) 3
 Hatching not indicated for sectional portions of an object. Fig(s) _____
 Cross section not drawn same as view with parts in cross section with regularly spaced parallel oblique strokes. Fig(s) _____

8. ARRANGEMENT OF VIEWS. 37 CFR 1.84(i)

- Words do not appear on a horizontal, left-to-right fashion when page is either upright or turned so that the top becomes the right side, except for graphs. Fig(s) _____

9. SCALE. 37 CFR 1.84(k)

- Scale not large enough to show mechanism with crowding when drawing is reduced in size to two-thirds in reproduction. Fig(s) _____
 Indication such as "actual size" or scale 1/2" not permitted. Fig(s) _____

10. CHARACTER OF LINES, NUMBERS, & LETTERS. 37 CFR 1.84(l)

- Lines, numbers & letters not uniformly thick and well defined, clean, durable, and black (except for color drawings). Fig(s) 1-7

11. SHADING. 37 CFR 1.84(m)

- Solid black shading areas not permitted. Fig(s) _____
 Shade lines, pale, rough and blurred. Fig(s) _____

12. NUMBERS, LETTERS, & REFERENCE CHARACTERS. 37 CFR 1.84(p)

- Numbers and reference characters not plain and legible. 37 CFR 1.84(p)(1) Fig(s) 1-7
 Numbers and reference characters not oriented in same direction as the view. 37 CFR 1.84(p)(1) Fig(s) _____
 English alphabet not used. 37 CFR 1.84(p)(2) Fig(s) _____
 Numbers, letters, and reference characters do not measure at least .32 cm. (1/8 inch) in height. 37 CFR(p)(3) Fig(s) 3-6

13. LEAD LINES. 37 CFR 1.84(q)

- Lead lines cross each other. Fig(s) _____
 Lead lines missing. Fig(s) _____

14. NUMBERING OF SHEETS OF DRAWINGS. 37 CFR 1.84(t)

- Sheets not numbered consecutively, and in Arabic numerals, beginning with number 1. Sheet(s) _____

15. NUMBER OF VIEWS. 37 CFR 1.84(u)

- Views not numbered consecutively, and in Arabic numerals, beginning with number 1. Fig(s) _____
 View numbers not preceded by the abbreviation Fig. Fig(s) _____

16. CORRECTIONS. 37 CFR 1.84(w)

- Corrections not made from prior PTO-948. Fig(s) _____

17. DESIGN DRAWING. 37 CFR 1.152

- Surface shading shown not appropriate. Fig(s) _____
 Solid black shading not used for color contrast. Fig(s) _____

COMMENTS:

ATTACHMENT TO PAPER NO.

REVIEWER

DATE

3/24/97



PATENT
Docket No. 1960053

UNITED STATES PATENT AND TRADEMARK OFFICE

In re patent application of

Applicant: Gary S. Watson et al
Serial No: 08/785,553
Filed: 12/13/96

For: INSTALLATION ORIENTATION OF AN ATTITUDE DETERMINING DEVICE
ONBOARD A CRAFT

Assistant Commissioner of Patents
Washington, D.C. 20231

#9
Prior
art
FJ
3-17-98

SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT

Sir:

1. Pursuant to 37 C.F.R. 1.97 and 1.98, and in compliance with 37 C.F.R. 1.56, the Office's attention is directed to the patents, publications and other information listed on the attached PTO-1449. A copy of each listed document is enclosed except for: (a) pending applications or (b) those previously cited or submitted to the Office in the following application(s) upon which this application relies for an earlier filing date under 35 U.S.C. 120:

Serial No.: _____
Filing Date: _____

Regarding any document, publication or other information for which a date is not given on the attached PTO-1449, Applicant(s) believe(s) the same may qualify as "prior" art to this application and should be treated accordingly, although Applicant(s) reserve(s) the right to contest the prior art status of any document, publication or information, should issue arise.

2. Regarding each listed document that is not in the English language, an English-language translation accompanies this Statement as indicated on the attached PTO-1449 or a concise explanation of the relevance of the document is set forth in the following document(s):

- ☐ (a) Copy of English language version of a search report indicating the degree of relevance found by the foreign office of each document being submitted from the search report.
- ☐ (b) Attachment entitled "Concise Explanation of Relevance of Non-English Language Documents".

3. Pursuant to 37 C.F.R. 1.97(b) this Statement is being filed:

- ☐ (a) Within 3 months of the filing date or date of entry into the National Stage.
- ☐ (b) Before the mailing date of a first Office Action on the merits. If this Statement is not filed before the mailing date of a first Office Action on the merits, the required certification is given below or, in the absence thereof, the Office is authorized to charge the required fee set forth in 37 C.F.R. 1.17(p) to Deposit Account No. 07-1625 for consideration of this Statement.

☒ (c) After the period set forth in 37 C.F.R. 1.97(b) but before the mailing date of either a final action or a notice of allowance.

☒ (1) The required certification is given below, or

☐ (2) Charge the fee set forth in 37 C.F.R. 1.17(p) to Deposit Account No. 07-1625.

☐ (d) After the mailing date of either a final action or a notice of allowance, but before payment of the issue fee. Petition hereby is made for consideration of this Statement and the required certification is indicated below.

☐ (1) Charge the fee set forth in 37 C.F.R. 1.17(i)(1) to Deposit Account No. 07-1625.

4. Certification (if applicable)

☒ (a) The undersigned hereby certifies that each item of information contained in this Statement was cited in a communication from a foreign patent office in a counterpart foreign application not more than 3 months prior to the filing of this Statement.

☐ (b) The undersigned hereby certifies that no item of information contained in this Statement was cited in a communication from a foreign patent office in a counterpart foreign application or, to the undersigned's knowledge after making reasonable inquiry, was known to any individual designated in 37 C.F.R. 1.56(c) more than 3 months prior to the filing of this Statement.

5. The Commissioner is hereby authorized to charge any additional fees or credit any overpayment to Deposit Account No. 07-1625.

Respectfully submitted,


William E. Zitel
Attorney for Applicants
Reg. No. 28,551

The B.F. Goodrich Company
9921 Brecksville Road
Brecksville, Ohio 44141-3289
Telephone: (216) 447-5921

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service on the date shown below as first class mail in an envelope addressed to: COMMISSIONER OF PATENTS AND TRADEMARKS, WASHINGTON, D.C. 20231, on the date signed below

Date: March 2, 1998

By: 
Cynthia L. Kemery



Pocket No. 1960053

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

re patent application of:

GARY S. WATSON *et al*

Sérial No: 08/785,553
 Filed: 12/13/96

Art Unit: 2214
 Examiner: Noori, M.

For: INSTALLATION ORIENTATION OF AN ATTITUDE DETERMINING
 DEVICE ONBOARD A CRAFT

ASSISTANT COMMISSIONER OF PATENTS
 Washington, D.C. 20231

PATENT

RECEIVED

MAR 13 1998

GROUP 2500

#10
 Reg Ext
 FJ
 3-17-98

PETITION UNDER 37 C.F.R. 1.136(a)

Sir:

Applicant(s) petition for an extension of time and fee therefor under 37 CFR § 1.136 for the total number of months checked below:

EXTENSION MONTHS	FEE FOR OTHER THAN SMALL ENTITY
<input type="checkbox"/> One Month	\$ 110.00
<input checked="" type="checkbox"/> Two Months	\$ 400.00
<input type="checkbox"/> Three Months	\$ 950.00
<input type="checkbox"/> Four Months	\$1,510.00

The Commissioner is hereby authorized to charge payment of \$400.00 for the associated this associated fee and any additional fees required under 37 CFR § 1.16 associated with this communication or credit any overpayment to Deposit Account No. 07-1625. A duplicate of this sheet is enclosed.

Respectfully submitted,

03/06/1998 SDRAVIS 00000056 DAW:071625 08785553
 01 FC:116 400.00 CH

William E. Zitelli
 William E. Zitelli
 Attorney for Applicants
 Reg. No. 28,551

The B.F. Goodrich Company
 Patent Law Department
 9921 Brecksville Road
 Brecksville, Ohio 44141-3289
 Telephone: (216) 447-5921

CERTIFICATE OF MAILING UNDER 37 C.F.R. §1.8(a)

I hereby certify that this correspondence is being deposited with the United States Post Office as first-class mail in an envelope addressed to: Commissioner of Patents and Trademarks, Washington, D.C. 20231 on

March 2, 1998
 Date of Deposit

by: *Cynthia L. Kemery*
 Cynthia L. Kemery



UNITED STATES PATENT AND TRADEMARK OFFICE

PATENT
Docket No. 1960053

In re patent application of:

GARY S. WATSON *et al*

Serial No.: 08/785,553
Filed: 12/13/96

Art Unit: 2214
Examiner: Noori, M.

11
Response
FJ
3-17-98

For: INSTALLATION ORIENTATION OF AN ATTITUDE DETERMINING DEVICE ONBOARD A
CRAFT

Assistant Commissioner of Patents
Washington, D.C. 20231

Amendment

Dear Sir:

In response to the Office Action dated October 9, 1997, it is respectfully requested that the claims of the above-identified application be reexamined and reconsidered for allowance based on the following remarks. A petition, including the fee, for a two-month extension of time is attached.

REMARKS

In the last Office Action, claims 1-2, 9-12, 16-17 and 20 were rejected under 35 U.S.C. 103(a) as being unpatentable over Achkar *et al*, in view of McMurtry, both of record. In addition, claims 3, 6, 13-15, 18-19 were rejected under 35 U.S.C. 103(a) as being unpatentable over Achkar *et al*, in view of McMurtry and further in view of Duncan *et al*. Claims 4-5 and 7-8 were objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Applicants acknowledge the allowability of dependent claims 4-5 and 7-8, but respectfully traverse the rejections of the remaining claims and support their position with the following remarks.

In regard to the obviousness rejection of claims 1-2, 9-12, 16-17 and 20, it is respectfully pointed out that claims 1 and 16 are method claims and the only independent claims of the instant application. Accordingly, claims 2, 9-12 are dependent either directly or indirectly from claim 1 and claims 17 and 20 are dependent either directly or indirectly from independent claim 16. In regard to Achkar *et al*, the Examiner asserts that the rate gyro calibration method and apparatus thereof include features of the claimed invention including: installing an attitude determining device on-board of said satellite, measuring an attitude of the said satellite, and compensating the attitude measurement error (Column 3, line 23). However, the attitude errors of the satellite and the estimated values used for compensation in Achkar *et al* are those concerned with drift and offset or bias errors inherent to the operation of the rate gyros themselves. See particularly Column 1, starting at line 58, where it is stated "it is essential to be able to estimate at any time during the service life of the satellite the drift effecting the rate gyros, or at least the constant part (bias) of such drift." In essence, Achkar is directed to a technique for estimating the bias of a rate sensor while in operation using a star or sun sensor as a long term reference or feed back to correct the bias or offset over time. See Column 2, starting at about line 61. Achkar in no way shape or form addresses the problem of errors in installation orientation and thus, would have no reason or motivation to compensate for such errors in installation.

Further, the Examiner acknowledges that Achkar does not explicitly recite the utilization of sensing the installation orientation (This is because the problem of errors in installation orientation is not addressed.) but, the utilization of compensation for installation orientation arrangement on-board of a mobile craft with respect to a predetermined coordinate system is well known in the art. McMurtry is presented to show such assertion. Applicants have reviewed McMurtry but can find no relationship whatsoever to the installation orientation of an attitude determining device on board a mobile craft. Rather, McMurtry is directed to a machine for measuring the dimensions of work

pieces supported on a table of the machine. McMurtry provides for a support arm and a head which is guided around the work piece attached to the table support for determining dimensions of the work piece. The improvement of McMurtry in this regard is a device for checking the accuracy of the coordinate positioning apparatus. Since Achkar does not teach or even suggest errors in installation orientation of an attitude device on board a mobile craft with respect to the reference coordinate system thereof, there would be no motivation in Achkar for use of any coordinate position apparatus for sensing the installation orientation of such a device. Further, McMurtry does not teach or suggest the installation orientation of an attitude device, the sensing thereof, or the compensation using the sensed installation orientation.

Independent claims 1 and 16 recite, in substance, a method of compensating for installation orientation of an attitude determining device on board a mobile craft comprising the steps of 1) installing the attitude determining device at an unknown orientation with respect to the reference coordinate system of the craft, 2) sensing the installation orientation while the craft is at rest to obtain a static orientation measurement of the device, and 3) compensating the craft attitude measurement of the device with the static orientation measurement. There is no teaching, suggestion or motivation in either Achkar or McMurtry themselves to modify one reference or the other or to combine the reference teachings to render independent claims 1 and 16 obvious in view of the combination thereof. Achkar and McMurtry, either taken individually or in combination, do not teach or suggest the aforementioned claim limitations of independent claims 1 and 16. Accordingly, Applicants contend that independent claims 1 and 16 are patentably distinguishable over the references to Achkar and McMurtry and respectfully request that the obviousness rejection thereof be withdrawn. Since the dependent claims 2, 9-12, 17 and 20 are dependent from either independent claim 1 or independent claim 16 and include all of the limitations of their parent claim they are also considered patentably distinguishable over the references to Achkar and McMurtry and the obviousness rejection thereof should also be withdrawn. There are further claim limitations

in dependent claims 9-12, 17 and 20 which are also clearly patentably distinguishable over the cited references, either taken individually or in combination.

Further in the last Office Action, dependent claims 3, 6, 13-15, 18 and 19 were also rejected under 35 U.S.C. 103(a) as being unpatentable over Achkar *et al* in view of McMurtry and further in view of Duncan *et al*, all of record. Duncan was added to the combination of references to Achkar and McMurtry to show an aircraft gyro system with means to sense acceleration in three axis. The Examiner asserts that it would have been obvious to one of ordinary skill in the art to modify the combination of Achkar/McMurtry with the teachings of Duncan *et al* to provide for acceleration sensors because Duncan *et al* makes it clear that utilization of said sensors are well known in the art and have been extensively described and discussed in the literature.

In response, Applicants have reviewed Duncan and have found that the acceleration sensors of Duncan are used for two purposes - first, for determining the initial conditions for integration of the rate gyros to establish the pitch and roll of the aircraft, e.g. to provide which way is up, and secondly, as a long term reference for attitude errors developed over time *i.e.* offset and bias errors of the rate gyros themselves which are fed back to the rate sensor for compensation. Duncan presumes a precise orientation of the gyro units relative to the aircraft axis, see Column 2, lines 38-39 and also Column 4, lines 36-39. Accordingly, starting from a precision alignment of the attitude determining device with the aircraft axis, there is no need for sensing errors of installation orientation and compensating attitude measurements as a result thereof utilizing accelerometers or any other device for that matter.

Therefore, none of the references cited against the claims, taken individually or in combination, teach, suggest or would motivate anyone towards a method of compensating for unknown installation orientations of an attitude-determining device with respect to the reference

coordinate system of a craft. Since the dependent claims 3, 6, 13-15, 18 and 19 are all dependent from either independent claim 1 or independent claim 16 and include all the limitations of their parent claims, they are considered patentably distinguishable over the references to Achkar, McMurtry and Duncan, either taken individually or in combination, for the same reasons given for their respective parent claims 1 and 16 as noted above.

Duncan does not add anything of substance to that taught by Achkar or McMurtry except for the use of accelerometers for the purposes of determining initial conditions for the integration of the rate gyros and for long term reference for compensation of drift and bias errors. None of the cited references Achkar, McMurtry or Duncan either taken individually or in combination teach, suggest or would motivate anyone to sense an unknown installation orientation of an attitude determining device, and compensate the craft attitude measurement of the device with the static orientation measurement to obtain attitude information of the crafts' reference coordinate system with respect to the earth frame coordinate system. In fact none of the references even address the issue of errors in installation orientation.

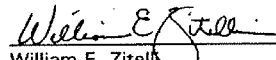
Applicants acknowledge the allowability of dependent claims 4-5 and 7-8, but believe the remaining claims of the instant application are also patentably distinguishable and allowable over the cited references of record. The prior art made of record and not relied upon but considered pertinent to applicants' disclosure was reviewed but found not to affect the patentability of the claims 1-20 of the instant application.

Applicants are submitting herewith by separate correspondence a Supplemental Information Disclosure form including references from a United Kingdom Search report for the counterpart UK patent application.

Accordingly, since the instant application is considered in condition for allowance an early issuance thereof is respectfully solicited.

The commissioner is hereby authorized to charge payment of any additional fees required under 37 CFR 1.16 associated with this communication or credit any overpayment to Deposit Account No. 07-1625.

Respectfully submitted,


William E. Zitelli
Attorney for Applicant(s)
Registration No. 28,551

Date: March 2, 1998
The B.F. Goodrich Company
9921 Brecksville Road
Brecksville, OH 44141-3289
Telephone: (216) 447-5921

CERTIFICATE OF MAILING

I hereby certify that this correspondence (along with any referred to as being attached or enclosed) is being deposited with the United States Postal Service on the date shown below with sufficient postage as first class mail in an envelope addressed to: COMMISSIONER OF PATENTS AND TRADEMARKS, WASHINGTON, D.C. 20231.

March 2, 1998
Date of Deposit

Cynthia L. Kemery
Depositor: Cynthia L. Kemery



GP 2214
\$

UNITED STATES PATENT AND TRADEMARK OFFICE

PATENT
Docket No: 1960053

Application of: GARY S. WATSON *et al*

Serial No.: 08/785,553
Filed: 12/13/96

RECEIVED

MAR 15 1998

GROUP 25

For: INSTALLATION ORIENTATION OF AN ATTITUDE DETERMINING
DEVICE ONBOARD A CRAFT

Assistant Commissioner of Patents
Washington, D.C. 20231

TRANSMITTAL LETTER

Transmitted herewith is/are the following document(s) related to the above-identified application:

- ☒ Acknowledgment of Receipt Card
- ☒ Amendment
- ☒ 2-Month Extension of Time
- ☒ Supplemental Information Disclosure with References

Charge to Deposit Account No. 07-1625 \$400.00

The Commissioner is hereby authorized to charge payment of any additional fees required under 37 CFR 1.16 associated with this communication or credit any overpayment to Deposit Account No. 07-1625. A duplicate of this sheet is enclosed.

Respectfully submitted,

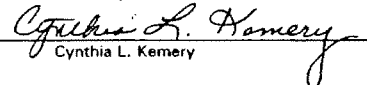

William E. Zitelli
Attorney for Applicant(s)
Registration No. 28,551

Date: March 2, 1998
The B.F. Goodrich Company
9921 Brecksville Road
Brecksville, OH 44141-3289
Telephone: (216) 447-5921

CERTIFICATE OF MAILING

I hereby certify that this correspondence (along with any referred to as being attached or enclosed) is being deposited with the United States Postal Service on the date shown below with sufficient postage as first class mail in an envelope addressed to the: COMMISSIONER OF PATENTS AND TRADEMARKS, WASHINGTON, D.C. 20231:

March 2, 1998
Date of Deposit


Depositor: Cynthia L. Kemery

Notice of Allowability	Application No. 08/785,553	Applicant(s) Watson
	Examiner Max H. Noori	Group Art Unit 2214

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance and Issue Fee Due or other appropriate communication will be mailed in due course.

☒ This communication is responsive to argument filed on 3/5/98

☒ The allowed claim(s) is/are 1-20

☐ The drawings filed on _____ are acceptable.

☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

☐ All ☐ Some* ☐ None of the CERTIFIED copies of the priority documents have been

☐ received.

☐ received in Application No. (Series Code/Serial Number) _____

☐ received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

*Certified copies not received: _____

☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

A SHORTENED STATUTORY PERIOD FOR RESPONSE to comply with the requirements noted below is set to EXPIRE THREE MONTHS FROM THE "DATE MAILED" of this Office action. Failure to timely comply will result in ABANDONMENT of this application. Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

☐ Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL APPLICATION, PTO-152, which discloses that the oath or declaration is deficient. A SUBSTITUTE OATH OR DECLARATION IS REQUIRED.

☒ Applicant MUST submit NEW FORMAL DRAWINGS

☐ because the originally filed drawings were declared by applicant to be informal.

☒ including changes required by the Notice of Draftsperson's Patent Drawing Review, PTO-948, attached hereto or to Paper No. 8

☐ including changes required by the proposed drawing correction filed on _____, which has been approved by the examiner.

☐ including changes required by the attached Examiner's Amendment/Comment.

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the reverse side of the drawings. The drawings should be filed as a separate paper with a transmittal letter addressed to the Official Draftsperson.

☐ Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Any response to this letter should include, in the upper right hand corner, the APPLICATION NUMBER (SERIES CODE/SERIAL NUMBER). If applicant has received a Notice of Allowance and Issue Fee Due, the ISSUE BATCH NUMBER and DATE of the NOTICE OF ALLOWANCE should also be included.

Attachment(s)

☐ Notice of References Cited, PTO-892

☒ Information Disclosure Statement(s), PTO-1449, Paper No(s). 3/5/98

☐ Notice of Draftsperson's Patent Drawing Review, PTO-948

☐ Notice of Informal Patent Application, PTO-152

☐ Interview Summary, PTO-413

☐ Examiner's Amendment/Comment

☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material

☒ Examiner's Statement of Reasons for Allowance

Serial Number: 08/785,558

Page 2

Art Unit: 2214

Reasons for Allowance

1. The following is an Examiner's Statement of Reasons for Allowance: The primary reason for allowance of the claims is that prior art neither teach nor fairly suggest the particular combinations of the method of compensating for installation orientation of an attitude sensor as appears in method claims 1 and 16. Major emphasis is being placed upon the provision of an "installing" an "altitude determination device" at an "unknown orientation" and "compensating" the result with a "static orientation measurement" in combination with other limitations of the said independent claim, and its dependent ones.

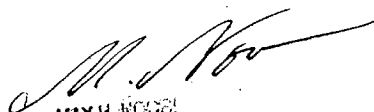
Any comments considered necessary by applicant must be submitted no later than the payment of the Issue Fee and, to avoid processing delays, should preferably **accompany** the Issue Fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

2. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Max H. Noori whose telephone number is (703) 308-5248. The examiner can normally be reached on Monday-Friday from 8:00 AM to 5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Rich Chilcot, can be reached on (703) 305-4716. The fax number for this group is (703) 308-7382.

Any inquiry of a general nature or relating to the status of this application should be directed to the Group receptionist whose telephone number is (703) 305-4900.

MHN
March 19, 1998


MAX H. NOORI
PATENT EXAMINER
GROUP 2200

3-19-98



UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office

NOTICE OF ALLOWANCE AND ISSUE FEE DUE

B2M1/0323

THE B F GOODRICH COMPANY
PATENT LAW DEPARTMENT
9921 BRECKSVILLE ROAD
BRECKSVILLE OH 44141-3289

APPLICATION NO.	FILING DATE	TOTAL CLAIMS	EXAMINER AND GROUP ART UNIT	DATE MAILED
08/785,553	12/13/96	020	NOORI, N	2214 03/23/98
First Named Applicant	WATSON, GARY S.			

TITLE OF INVENTION: METHOD OF COMPENSATING FOR INSTALLATION ORIENTATION OF AN ATTITUDE DETERMINING DEVICE ONBOARD A CRAFT (AS AMENDED)

ATTY'S DOCKET NO.	CLASS-SUBCLASS	BATCH NO.	APPLN. TYPE	SMALL ENTITY	FEE DUE	DATE DUE
3	1960053	073-181.000	B97 UTILITY	NO	\$1320.00	06/23/98

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED.

THE ISSUE FEE MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED.

HOW TO RESPOND TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

- A. If the status is changed, pay twice the amount of the FEE DUE shown above and notify the Patent and Trademark Office of the change in status, or
- B. If the status is the same, pay the FEE DUE shown above.

If the SMALL ENTITY is shown as NO:

- A. Pay FEE DUE shown above, or
- B. File verified statement of Small Entity Status before, or with, payment of 1/2 the FEE DUE shown above.

II. Part B-Issue Fee Transmittal should be completed and returned to the Patent and Trademark Office (PTO) with your ISSUE FEE. Even if the ISSUE FEE has already been paid by charge to deposit account, Part B Issue Fee Transmittal should be completed and returned. If you are charging the ISSUE FEE to your deposit account, section "4b" of Part B-Issue Fee Transmittal should be completed and an extra copy of the form should be submitted.

III. All communications regarding this application must give application number and batch number. Please direct all communications prior to issuance to Box ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PATENT AND TRADEMARK OFFICE COPY



**UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office**

Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, DC 20231

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
08/785,553	12/13/96	WATSON	196053

THE B F GOODRICH COMPANY
PATENT LAW DEPARTMENT
9921 BRECKSVILLE ROAD
BRECKSVILLE OH 44141-3289

B2M1/0323

EXAMINER
NOORI, M

ART UNIT	PAPER NUMBER
2214	

DATE MAILED: 03/23/98

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

**ACCESS ACKNOWLEDGMENT
and
SECURITY ORDER RECOMMENDATION BY DEFENSE AGENCY**

Application Serial No.: 08/785,553

Defense Agency: Army

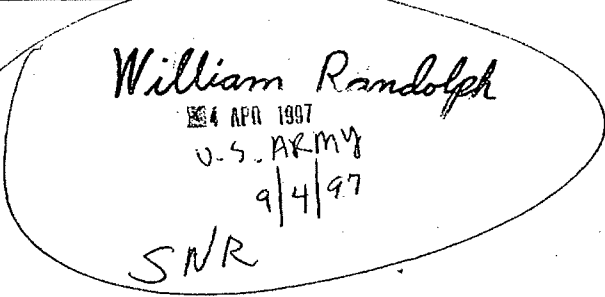
Filing Date: 01/13/97

Date Referred: 03/31/97

I hereby acknowledge as indicated by my signature on this form that I have inspected this application in administration of 35 USC 181 on behalf of the Agency/Command specified below. I promise not to divulge any information from this application for any purpose other than administration of 35 USC 181.

Recommendation
(e.g., 'Security Not Recommended (SNR)')

Reviewer(s) Signature/Date/Command

	
--	---

Instructions to Reviewers:

1. All individuals reviewing this application are required under 35 USC 181 to sign and date this form regardless of whether they are making a security order recommendation.
2. The attached copy of the application, any copies made therefrom and this form must be returned to the PTO once a recommendation not to impose security has been made or a security order has been rescinded.

Time for Completion of Review:

Pursuant to 35 U.S.C. 184, the subject matter of this application may be filed in a foreign country for the purpose of filing a patent application without a license any time after the expiration of 6 months from filing date unless the application becomes the subject of a security order.



**ACCESS ACKNOWLEDGMENT
and
SECRECY ORDER RECOMMENDATION BY DEFENSE AGENCY**

Application Serial No.: 08/785,553

Defense Agency: Navy

Filing Date: 01/13/97

Date Referred: 03/31/97

I hereby acknowledge as indicated by my signature on this form that I have inspected this application in administration of 35 USC 181 on behalf of the Agency/Command specified below. I promise not to divulge any information from this application for any purpose other than administration of 35 USC 181.

Recommendation

(e.g., 'Secrecy Not Recommended (SNR)')

Reviewer(s) Signature/Date/Command

SNR	Ana D. Offir 5/5/97 NAVY
-----	--------------------------

Instructions to Reviewers:

1. All individuals reviewing this application are required under 35 USC 181 to sign and date this form regardless of whether they are making a secrecy order recommendation.
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OW
5/8

**ACCESS ACKNOWLEDGMENT
and
SECURITY ORDER RECOMMENDATION BY DEFENSE AGENCY**

Application Serial No.: 08/785,553

Defense Agency: AirForce

Filing Date: 01/13/97

Date Referred: 03/31/97

I hereby acknowledge as indicated by my signature on this form that I have inspected this application in administration of 35 USC 181 on behalf of the Agency/Command specified below. I promise not to divulge any information from this application for any purpose other than administration of 35 USC 181.

Recommendation

(e.g., 'Security Not Recommended (SNR)')

Reviewer(s) Signature/Date/Command

SNR	<i>M. Jordan, 2 April 97, AFSA/TAM</i> <i>Clyde E. Allison, 9 April 97, WL/FIIC</i>
-----	--

Instructions to Reviewers:

1. All individuals reviewing this application are required under 35 USC 181 to sign and date this form regardless of whether they are making a security order recommendation.
2. The attached copy of the application, any copies made therefrom and this form must be returned to the PTO once a recommendation not to impose secrecy has been made or a security order has been rescinded.

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**UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office**

 Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

SERIAL NUMBER	FILING DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NO.
08/785,553	12/13/96	WATSON	G 1960053

OF RECORD:

 THE B F GOODRICH COMPANY
PATENT LAW DEPARTMENT
9921 BRECKSVILLE ROAD
BRECKSVILLE OH 44141-3289

07N1/0409

EXAMINER	
NOORI, M	
ART UNIT	PAPER NUMBER
2855	14

DATE MAILED:

04/09/98

STATEMENT UNDER SECTION 305(c) NASA
(90 DAY LETTER TO NASA)

A statement under Section 305(c) of the National Aeronautics and Space Act of 1958 (Public Law 568, 85th Congress), concerning the making of the invention or discovery described therein, has been filed in the above identified application. Copies of the statement and required application papers are forwarded herewith.

A dated acknowledgment of the receipt of the copies of the statement and required application papers is requested to determine the starting of the 90-day period recited in Section 305(d) of the Act. An endorsed copy of this letter is provided for this purpose.

By direction of the Commissioner

SPECIAL LAWS ADMINISTRATION GROUP

 Encl. Photo statement
Photo application papers
Receipt of copy of this letter

Receipt is acknowledged of a copy of the above letter and its enclosures.

Date

Signed

THIS CORRESPONDENCE TO:

 The Honorable
The Administrator
National Aeronautics and
Space Administration
Washington, D.C. 20546


UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office

 Address: COMMISSIONER OF PATENTS AND TRADEMARKS
 Washington, D.C. 20231

SERIAL NUMBER	FILING DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NO.
08/785,553	12/13/96	WATSON	G 1960053

OF RECORD:

 THE B. F. GOODRICH COMPANY
 PATENT LAW DEPARTMENT
 9921 BRECKSVILLE ROAD
 BRECKSVILLE OH 44141-3289

07N1/0409

EXAMINER	
NOORI, M	
ART UNIT	PAPER NUMBER
2855	

DATE MAILED:

04/09/98

 RECEIVED
 LICENSING & REVIEW
 98 APR 20 PM 3:08

STATEMENT UNDER SECTION 305(c) NASA
(90 DAY LETTER TO NASA)

A statement under Section 305(c) of the National Aeronautics and Space Act of 1958 (Public Law 568, 85th Congress) concerning the making of the invention or discovery described therein, has been filed in the above identified application. Copies of the statement and required application papers are forwarded herewith.

A dated acknowledgment of the receipt of the copies of the statement and required application papers is requested to determine the starting of the 90-day period recited in Section 305(d) of the Act. An endorsed copy of this letter is provided for this purpose.

By direction of the Commissioner

SPECIAL LAWS ADMINISTRATION GROUP

 Encl. Photo statement
 Photo application papers
 Receipt of copy of this letter

 RECEIVED
 98 APR 16 AM 7:36
 NASA HEADQUARTERS
 (INTEL. PROPERTY)

Receipt is acknowledged of a copy of the above letter and its enclosures.

 4-16-98
 Date

Signed

Kathy Bays

THIS CORRESPONDENCE TO:
 The Honorable
 The Administrator
 National Aeronautics and
 Space Administration
 Washington, D.C. 20546

#16
W. J. Jeter
 7/23/98
 RECEIVED
 LICENSING & REVIEW
 JUL 27 AM 10:57

National Aeronautics and
 Space Administration
 Headquarters
 Washington, DC 20546-0001



Reply to Attn of: GP

July 15, 1998

The Commissioner of Patents and Trademarks
 Attn: Crystal Jeter
 Washington, DC 20231

Dear Ms. Jeter:

The patent applications listed below are in response to the action taken under Subsection 305(c) of the National Aeronautics and Space Act of 1958.

08/715,065	08/637,874	08/430,552	08/554,131	08/819,849	08/783,519
08/767,931	08/721,890	08/772,672	08/597,083	08/553,790	08/785,553
08/682,026	08/577,433	08/797,878	08/639,230	08/486,377	08/648,781

You are hereby advised, on the basis of the information presently available on said applications and statements, that the Administrator does not intend to invoke the provisions of Subsection 305(d) of the National Aeronautics and Space Act of 1958.

Sincerely,

Kathy Beyer
 Kathy Beyer
 Office of the Associate
 General Counsel
 (Intellectual Property)



~~0-1-181~~
~~0-1-181~~
 PATENT
 Docket No.: 1960053
 Notice of Allowance Date: 03/23/98
 Issue Batch: B97

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

LOC: 7200 ChLoc 4/100 LOCDT 9-17-98

In the Application of: Gary S. Watson

Serial No: 08/785,553
 Filed: 12/13/96

Art Unit: 2214
 Examiner: Noori, M.

For: METHOD OF COMPENSATING FOR INSTALLATION ORIENTATION OF AN
 ATTITUDE DETERMINING DEVICE ONBOARD A CRAFT (AS AMENDED)

ASSISTANT COMMISSIONER OF PATENTS
 BOX OFFICIAL DRAFTSMAN
 WASHINGTON, D.C. 20231

LETTER TO OFFICIAL DRAFTSMAN

Dear Sir:

We are hereby submitting the Formal Drawings to replace the Informal Drawings originally filed with the above-identified application.

The attached Formal Drawings include the amendments required by the Office Draftsman on the Form PTO-948 dated 03/24/97 (attachment to Paper No. 8), which were noted by the Examiner in the Notice of Allowability dated 03/23/98.

The Commissioner is hereby authorized to charge payment of any filing fees required under 37 CFR 1.16 associated with this communication or credit any overpayment to Deposit Account No. 07-1625.

Respectfully submitted,

William E. Zitelli
 Attorney for Applicants
 Reg. No. 28,551

The B.F. Goodrich Company
 Patent Law Department
 9921 Brecksville Road
 Brecksville, Ohio 44141-3289
 Telephone: (216) 447-5921

CERTIFICATE OF MAILING UNDER 37 C.F.R. §1.8(a)

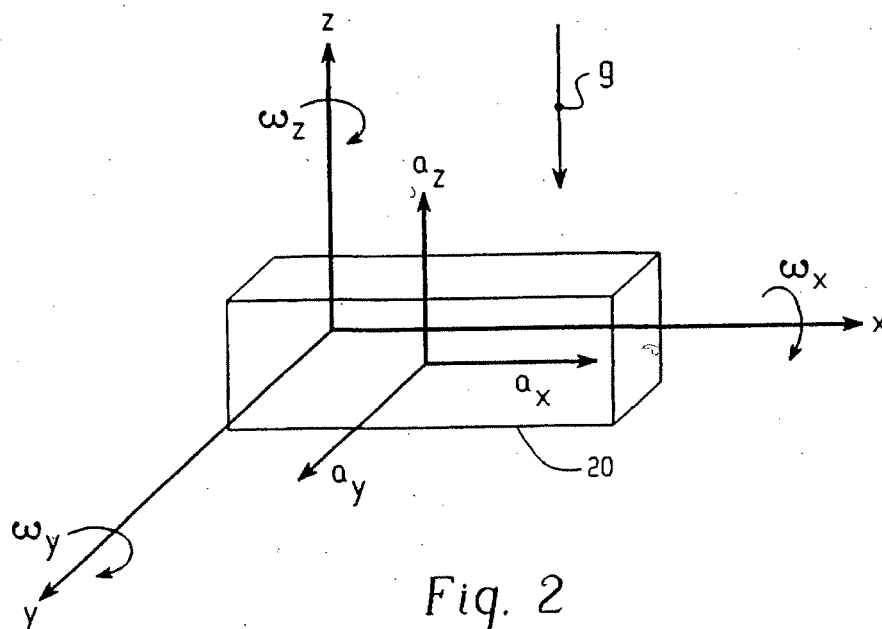
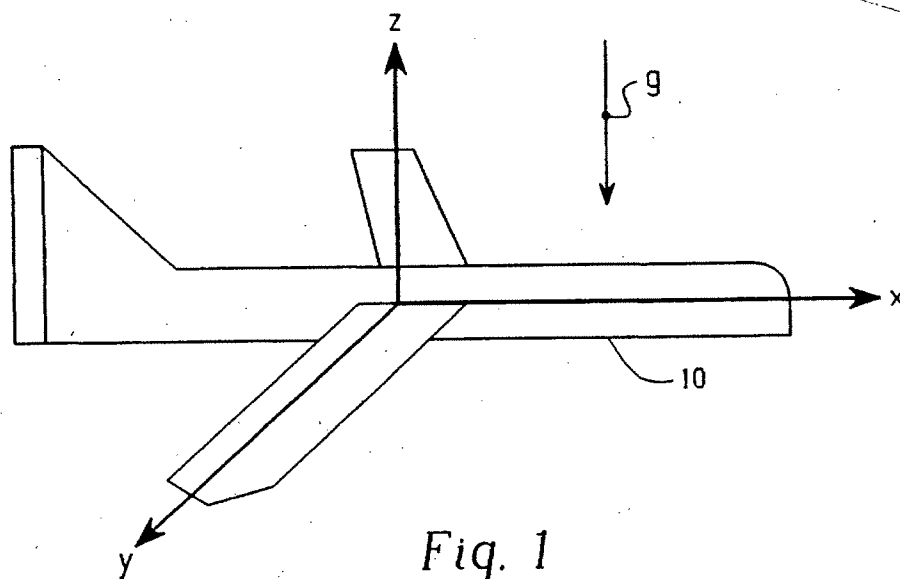
I hereby certify that this correspondence is being deposited with the United States Post Office as first-class mail in an envelope addressed to the Commissioner of Patents and Trademarks, Washington, D.C. 20231 on the date below.

Date of Deposit

Depositor: Cynthia L. Kemery

APPROVED	O.G. FIG.	
BY	CLASS	SUBCLASS
DRAFTSMAN		

5841018



APPROVED	O.G. FIG.	
BY	CLASS	SUBCLASS
DRAFTSMAN		

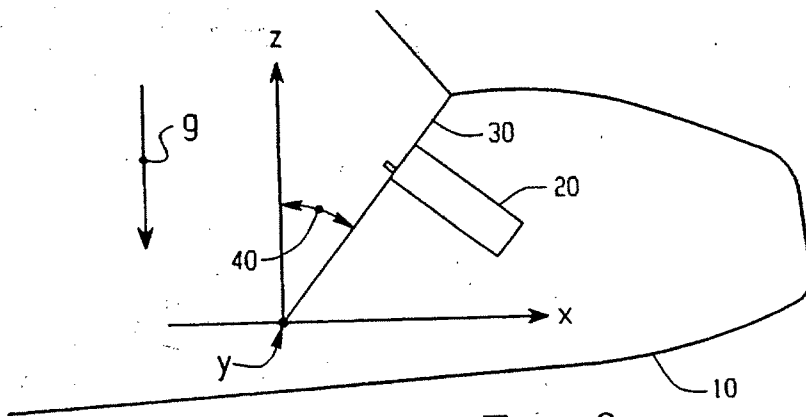


Fig. 3

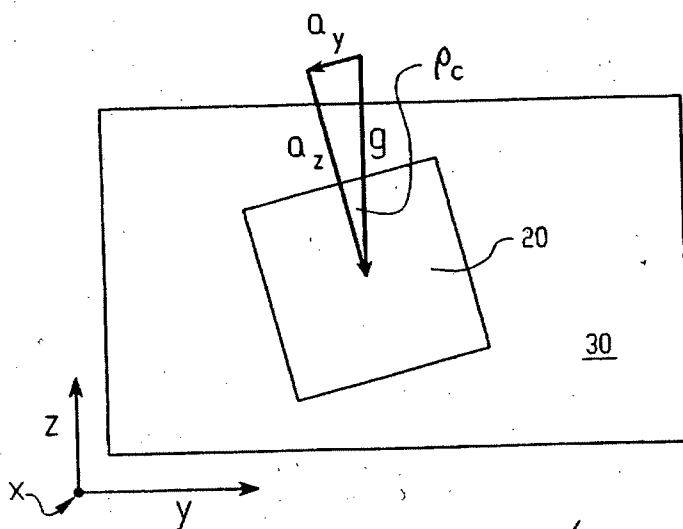
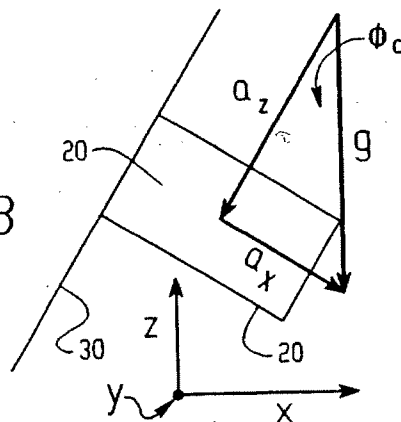


Fig. 4A

Fig. 4B



APPROVED	O.G. FIG.	
BY	CLASS	SUBCLASS
DRAFTSMAN		

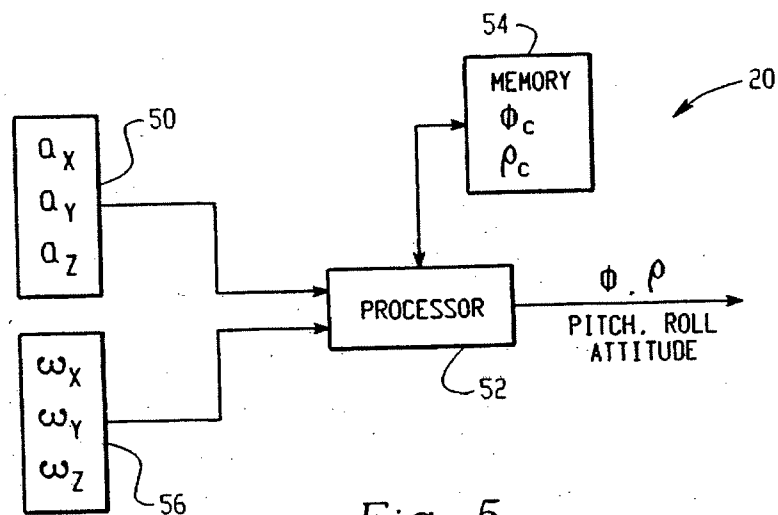


Fig. 5

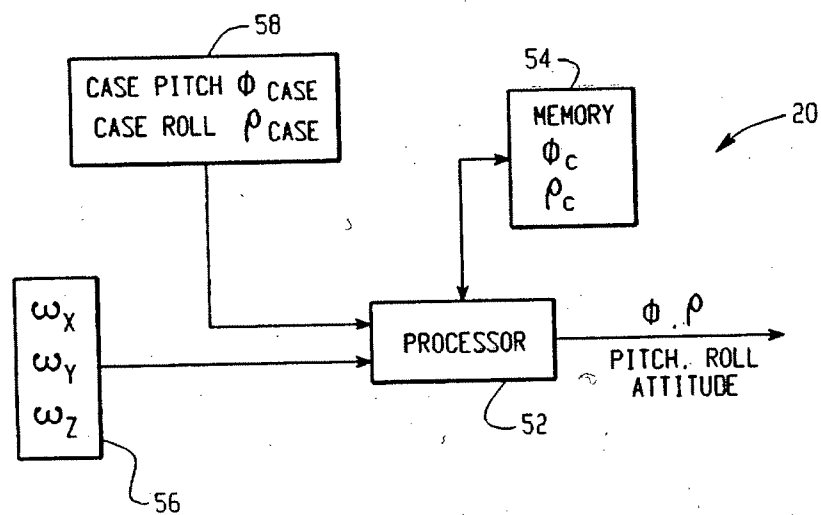
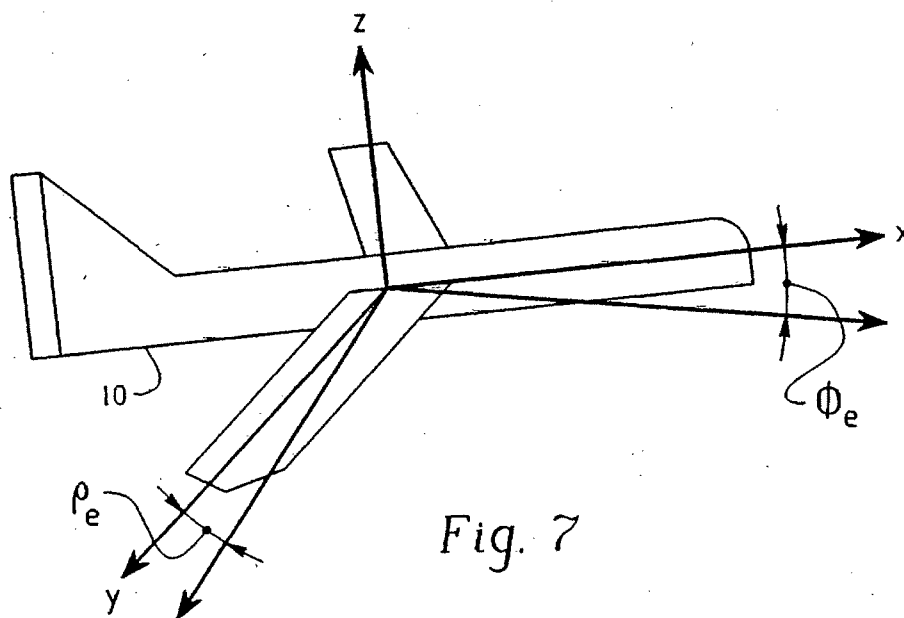


Fig. 6

APPROVED	O.G.:FIG.	
BY	CLASS	SUBCLASS
DRAFTSMAN		



PART B—ISSUE FEE TRANSMITTAL

Complete and mail this form, together with applicable fees, to: Box ISSUE FEE
Assistant Commissioner for Patents
Washington, D.C. 20231

36 N1

CHrg

8-93

7200

MAILING INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE. Blocks 1 through 4 should be completed where appropriate. All further correspondence including the Issue Fee Receipt, the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Legibly mark-up with any corrections or use Block 1)

THE B F GOODRICH COMPANY
PATENT LAW DEPARTMENT
9921 BRECKSVILLE ROAD
BRECKSVILLE OH 44141-2289

RECEIVED
Publishing Division

JUN 01 1998

11

Note: The certificate of mailing below can only be used for domestic mailings of the Issue Fee Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing.

Certificate of Mailing

I hereby certify that this Issue Fee Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Box Issue Fee address above on the date indicated below.

Cynthia L. Kemery (Depositor's name)

Cynthia L. Kemery (Signature)

May 27, 1998 (Date)

APPLICATION NO.	FILING DATE	TOTAL CLAIMS	EXAMINER AND GROUP	ART UNIT	DATE MAILED
08/785,553	12/13/96	020	NOORI, M	2214	03/23/98

First Named Applicant: WATSON, GARY S.

TITLE OF INVENTION: METHOD OF COMPENSATING FOR INSTALLATION ORIENTATION OF AN ATTITUDE DETERMINING DEVICE ONBOARD A CRAFT (AS AMENDED)

ATTY'S DOCKET NO.	CLASS-SUBCLASS	BATCH NO.	APPLN. TYPE	SMALL ENTITY	FEE DUE	DATE DUE
3 1960053	073-181.000	B97	UTILITY	NO	\$1320.00	06/23/98

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.383). Use of PTO form(s) and Customer Number are recommended, but not required.

- ☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
- ☐ "Fee Address" Indication (or "Fee Address" Indication form PTO/SB/47) attached.

2. For printing on the patent front page, list (1) the names of up to 3 registered patent attorneys or agents OR, alternatively, (2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 William E. Zitelli

2

3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)
PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. Inclusion of assignee data is only appropriate when an assignment has been previously submitted to the PTO or is being submitted under separate cover. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE BFGoodrich Avionics Systems, Inc.

(B) RESIDENCE: (CITY & STATE OR COUNTRY) Akron, Ohio

Please check the appropriate assignee category indicated below (will not be printed on the patent)

☐ Individual ☒ corporation or other private group entity ☐ government

4a. The following fees are enclosed (make check payable to Commissioner of Patents and Trademarks):

- ☐ Issue Fee
- ☐ Advance Order - # of Copies 10

4b. The following fees or deficiency in these fees should be charged to:
DEPOSIT ACCOUNT NUMBER 07-1625
(ENCLOSE AN EXTRA COPY OF THIS FORM)

- ☒ Issue Fee
- ☒ Advance Order - # of Copies 10

The COMMISSIONER OF PATENTS AND TRADEMARKS IS requested to apply the Issue Fee to the application identified above.

(Authorized Signature) William E. Zitelli (Date) 5-27-98

NOTE: The Issue Fee will not be accepted from anyone other than the applicant, a registered attorney or agent, or the assignee or other party in interest as shown by the records of the Patent and Trademark Office.

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending on the needs of the individual case. Any comments on the amount of time required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, D.C. 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND FEES AND THIS FORM TO: Box Issue Fee, Assistant Commissioner for Patents, Washington D.C. 20231

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

06/05/1998 LBERGER 00000065 071625 08785553

01 FC:142 1320.00 CH
02 FC:561 30.00 CH

TRANSMIT THIS FORM WITH FEE

The
United
States
of
America



PTO UTILITY GRANT

Paper Number 18

The Commissioner of Patents and Trademarks

Has received an application for a patent for a new and useful invention. The title and description of the invention are enclosed. The requirements of law have been complied with, and it has been determined that a patent on the invention shall be granted under the law.

Therefore, this

United States Patent

Grants to the person(s) having title to this patent the right to exclude others from making, using, offering for sale, or selling the invention throughout the United States of America or importing the invention into the United States of America for the term set forth below, subject to the payment of maintenance fees as provided by law.

If this application was filed prior to June 8, 1995, the term of this patent is the longer of seventeen years from the date of grant of this patent or twenty years from the earliest effective U.S. filing date of the application, subject to any statutory extension.

If this application was filed on or after June 8, 1995, the term of this patent is twenty years from the U.S. filing date, subject to an statutory extension. If the application contains a specific reference to an earlier filed application or applications under 35 U.S.C. 120, 121 or 365(c), the term of the patent is twenty years from the date on which the earliest application was filed, subject to any statutory extension.

Bruce Lehman
Commissioner of Patents and Trademarks

Armita Mansey
Attest

Form PTO-1584 (Rev. 2/97)

04cv12672NG

AO 120 (Rev. 3/04)

TO: Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
---	--

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court for District of Massachusetts on the following ☒ Patents or ☒ Trademarks:

DOCKET NO. 04-12672 NG	DATE FILED 12/21/04	U.S. DISTRICT COURT for the District of Massachusetts
PLAINTIFF Avidyne Corporation		DEFENDANT L-3 Avionics Systems, Inc. t/k/a B.F. Goodrich Avionics Systems, Inc.
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1 5,841,018	11/24/98	BF Goodrich
2		
3		
4		
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In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY	<input type="checkbox"/> Amendment	<input type="checkbox"/> Answer	<input type="checkbox"/> Cross Bill	<input type="checkbox"/> Other Pleading
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK			
1					
2					
3					
4					
5					

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT		
CLERK	(BY) DEPUTY CLERK	DATE

Copy 1—Upon initiation of action, mail this copy to Director Copy 3—Upon termination of action, mail this copy to Director
 Copy 2—Upon filing document adding patent(s), mail this copy to Director Copy 4—Case file copy

PATENT APPLICATION SERIAL NO. _____

08 785553

U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE
FEE RECORD SHEET

360 GL 07-1625 02/19/97 08785553
36170 101 770.00CH 1960053

PATENT APPLICATION FEE DETERMINATION RECORD					Application or Docket Number	
Effective October 1, 1996					785 553	
CLAIMS AS FILED - PART I						
(Column 1)		(Column 2)		SMALL ENTITY		OR
FOR	NUMBER FILED	NUMBER EXTRA		RATE	FEE	OTHER THAN SMALL ENTITY
BASIC FEE	[REDACTED]			[REDACTED]	385.00	[REDACTED] 770.00
TOTAL CLAIMS	20	minus 20 =	*	x\$11=		x\$22=
INDEPENDENT CLAIMS	2	minus 3 =	*	x40=		x80=
MULTIPLE DEPENDENT CLAIM PRESENT				+130=		+260=
* If the difference in column 1 is less than zero, enter "0" in column 2				TOTAL		TOTAL 770
CLAIMS AS AMENDED - PART II						
(Column 1)		(Column 2)		SMALL ENTITY		OR
AMENDMENT A	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE	ADDITIONAL FEE	OTHER THAN SMALL ENTITY
Total	*	Minus	**	x\$11=		x\$22=
Independent	*	Minus	***	x40=		x80=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				+130=		+260=
TOTAL ADDIT. FEE						TOTAL ADDIT. FEE
(Column 1)		(Column 2)		SMALL ENTITY		OR
AMENDMENT B	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE	ADDITIONAL FEE	OTHER THAN SMALL ENTITY
Total	*	Minus	**	x\$11=		x\$22=
Independent	*	Minus	***	x40=		x80=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				+130=		+260=
TOTAL ADDIT. FEE						TOTAL ADDIT. FEE
(Column 1)		(Column 2)		SMALL ENTITY		OR
AMENDMENT C	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE	ADDITIONAL FEE	OTHER THAN SMALL ENTITY
Total	*	Minus	**	x\$11=		x\$22=
Independent	*	Minus	***	x40=		x80=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				+130=		+260=
TOTAL ADDIT. FEE						TOTAL ADDIT. FEE

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
 ** If the "Highest Number Previously Paid For" in THIS SPACE is less than 20, enter "20."
 *** If the "Highest Number Previously Paid For" in THIS SPACE is less than 3, enter "3."
 The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

PACE DATA ENTRY CODING SHEET

U.S. DEPARTMENT OF COMMERCE
Patent and Trademark Office

1ST EXAMINER	
2ND EXAMINER	

DATE	5/17/97
DATE	

APPLICATION NUMBER

TYPE 1

APPL

FILING DATE

MONTH DAY YEAR

0 1 1 3 9 7 7

SPECIAL HANDLING	GROUP ART UNIT	CLASS
0	3107	244

SHEETS OF DRAWING		
1	1	4

TOTAL CLAIMS			INDEPENDENT CLAIMS		
	-2	0		-	2

SMALL
ENTITY? ☐

FILING FEE			
1	7	7	8

FOREIGN
LICENSE

1	9	6	0	0	5	3			
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CONTINUITY DATA

CONT	STATUS
CODE	CODE

PARENT APPLICATION SERIAL NUMBER

[illegible][illegible]

PARENT FILING DATE		
MONTH	DAY	YEAR

[illegible]

P	C	T
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PCT/FOREIGN APPLICATION DATA

**FOREIGN
PRIORITY
CLAIMED**

COUNTRY
CODE[illegible]

FOREIGN FILING DATE		
MONTH	DAY	YEAR

1	2	3	4	5
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[illegible][illegible]



The
Patent
Office

Application No: GB 9717887.5
Claims searched: 1-24

Examiner: C B VOSPER
Date of search: 15 January 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:
UK CI (Ed.P): B7W, B7V(VHP,VHR)
Int CI (Ed.6): B63B 39/00,39/14; B64D 43/00,45/00; G01C 23/00, G01D 18/00
Other: ONLINE WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	GB 1574270 SUNDSTRAND (whole document - compensation of attitude signal)	
A	EP 0744590 A2 STATE OF ISRAEL (whole document - compensating for initial vehicle attitude when determining datum for I.M.U. (which determines, inter alia, attitude)	
A	WO 87/01349 A1 BRITISH PETROLEUM (whole document - compensation of attitude signal)	
A	US 5612687 CESCO/AEROSPATIALE (col. 2, line 14 et seq. - use of reference attitude to correct attitude of instrument support structure.)	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Staple Issue Slip Here

POSITION	ID NO.	DATE
CLASSIFIER	5	3-6-97
EXAMINER	380	3/7/97
TYPIST	W8	3/19
VERIFIER		
CORPS CORR.		
SPEC. HAND		
FILE MAINT.		
DRAFTING		

INDEX OF CLAIMS

Claim	Date
1	10/3/97
2	2/1/98
3	3/1/98
4	4/1/98
5	5/1/98
6	6/1/98
7	7/1/98
8	8/1/98
9	9/1/98
10	10/1/98
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SYMBOLS

✓ Rejected

□ Allowed

(Through numeral) Cancelled

W Restricted

I Non-elected

A Interference

O Appeal

O Objected

Claim	Date
51	
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SEARCHED			
Class	Sub.	Date	Exmr.
73	1.79		
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	1.78		
	1.75		
	1.76		
	1.77		
	178R		
244	164		
"	171	10-6-77	MA

SEARCH NOTES		
	Date	Exmr.
APS mg	10-6-77	MA

INTERFERENCE SEARCHED			
Class	Sub.	Date	Exmr.
73	1.81		
73	178R	3-19-98	MA